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(PS – THE T-SHIRT IS A LIE)

PLAYSTATION 2
022 HOW IT WORKS

GEFORCE2 ULTRA
044 BIG GAME POWER

OVERCLOCK DURON
046 WITH A PENCIL!

EDHEAD

Ten years young...

Gee whiz, look at that – we can now say that Atomic's been kicking out the clock for ten... whole YEARS.

We're calling it the Atomic Decade, and we're going to be celebrating it all year.

We're kicking things off this issue with a look back at some of the best articles we've ever published. During our issue 100 celebrations, we asked you who your favourite writers were, and so for our 10th birthday we've used that list as the basis of a little retrospective series. The issue you're holding in your hands right now is sixteen pages longer, and those pages are packed with rare publishing condensate we like to call awesomeonium.

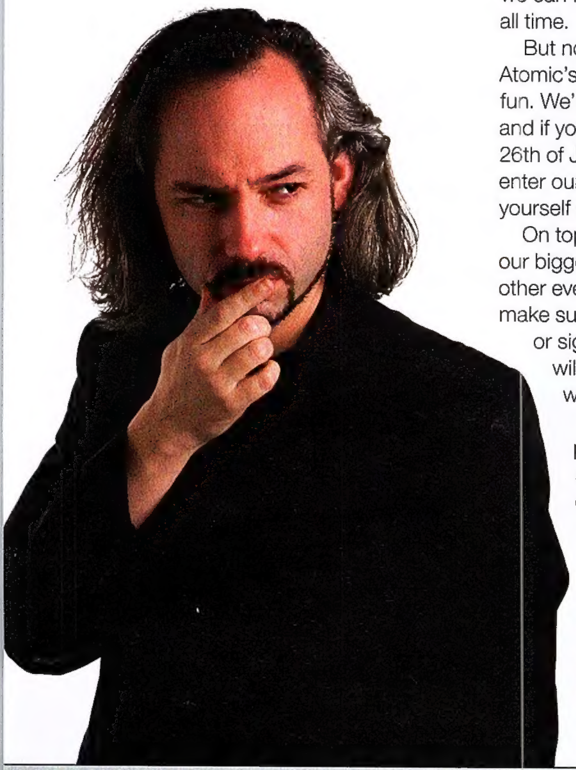
We've got articles from Logan Booker, John Gillooly, Dan Rutter and Ashton Mills – the true Atomic elite. In fact, these are articles chosen by them as their favourites, and throughout the year we're planning on publishing some more classic pieces. What we're hoping you'll do is not only go "Wow, I remember this – awesome!" or "Wow, I missed this one – awesome!", and then tell me your favourites overall, so that we can find out the best article of all time.

But nostalgia and celebrating Atomic's best work is just a part of the fun. We're throwing a party, of course, and if you're reading this before the 26th of January you've got a chance to enter our thrilling competition and score yourself a spot!

On top of that, this year's going to be our biggest ever for gaming LANs and other events. You will definitely want to make sure you check the site regularly, or sign up for our newsletter – these will be awesome nights you do not want to miss out on.

We're also working up to a pretty neat little offer for our lovely subscribers, so if you're not part of that elite little cadre, you might want to consider it soon.

Big times, for a big damn hero of a magazine.



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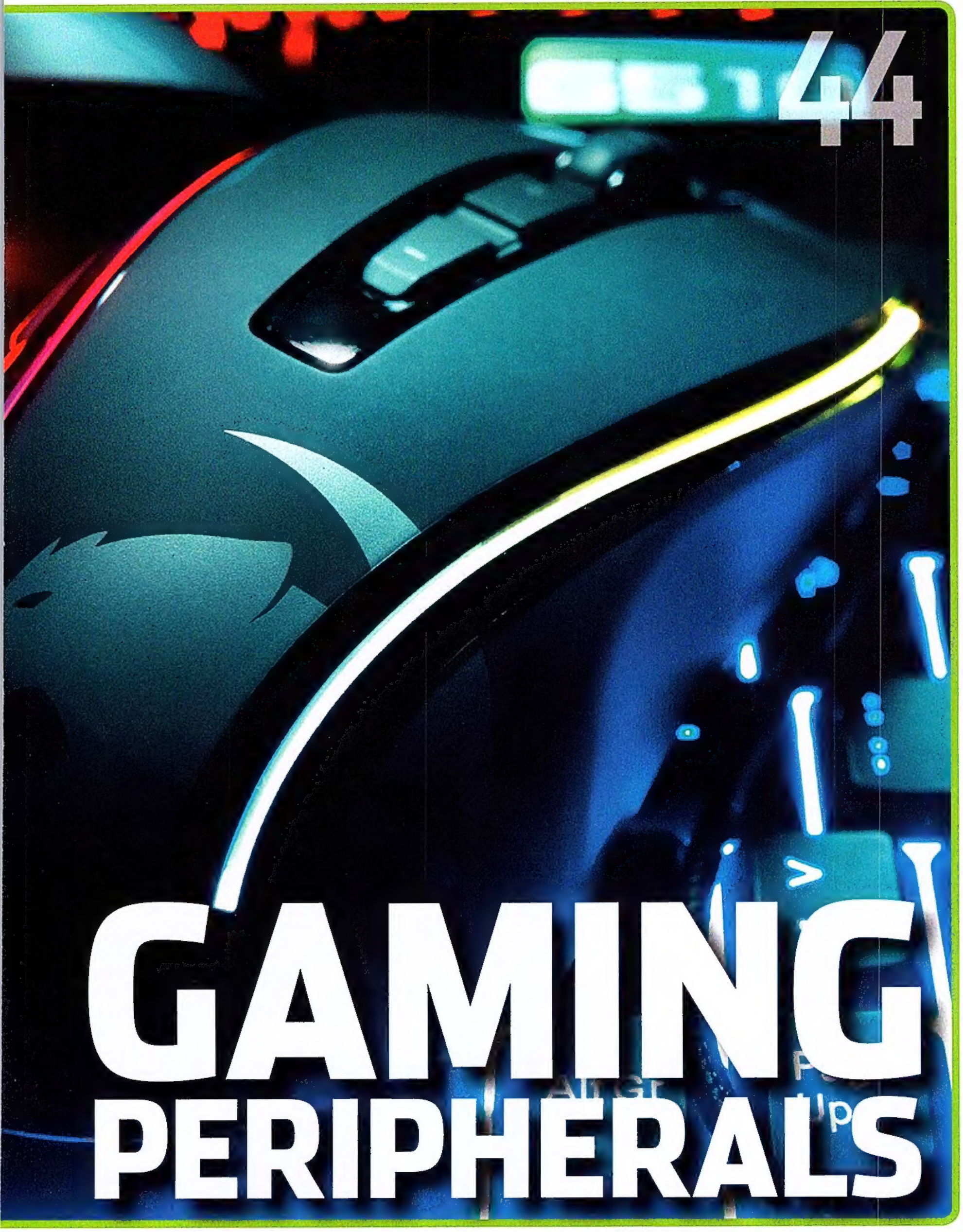

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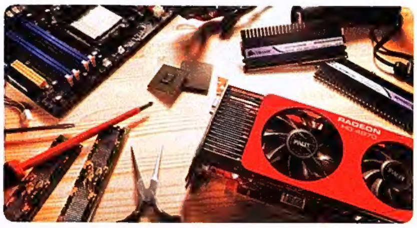

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R18+: No news is ... no news.

It's the update that isn't, unfortunately: No decision on the R18+ rating for games will be made for now.

The gaming and tech community has been on tenterhooks waiting to hear whether the Attorneys General would finally introduce a long-awaited and long-overdue R18+ rating for games following their meeting today. The government's in favour. According to a number of polls, the public is in favour. And we are definitely in favour.

But it seems some people aren't quite sure yet. Brendan O'Connor, the Minister for Home Affairs, held a very brief press conference following December's meeting of the State Attorney Generals to announce that after a day of presentations and discussion, no decision will be reached today. The sticking point seems to be the WA Attorney General wanting to consult with cabinet before making a decision. The Attorneys General also want more information on how the R18+ rating would affect what we already have. It looks like the issue did go to a vote, but the decision was not unanimous - which it needs to be for the rating to be introduced.

O'Connor said the issue was moving forward, despite the decision (or lack thereof). The Attorneys General meet again early in the new year, and this will be brought up again then, with a study on new gaming classifcation guidelines hopefully completed in the meantime.

For now? We wait. And we lobby. Sensibly - going off the deep end might be tempting, but it's not going to help convince anyone that gamers are ready to be treated like the adults that we are.

you said...

Redhatter: *"I think while the progress is slow, it is progress, and it can't make things much worse than they are now."*

sirtrancealot: *"98 per cent in favour of 70,000 public submissions, this should be a no brainer... even for those with no brains."*

With a bit of hindsight, it really is looking like R18 will happen – just not quickly. –ed.

Gaming industry thinks of the children

In a small aside to the R18+ debate, the video game industry today begins educating parents on how to stay on top of their kids gaming habits.

The Interactive Games and Entertainment Association (IGEA) has today released a series of videos to teach parents how to better control the gaming habits of their children. The first videos (**http://www.youtube.com/user/igeavideo?feature=mhum#p/u**) look at how to set up parental controls on most popular consoles, theoretically restricting the amount of time kids spend playing and what they play (including classification restrictions).

The move comes on the back of a 2009 survey that showed most parents were unaware that consoles even had parental controls.

The IGEA also has a range of general tips on how parents can best think of the children, including all the seemingly no-brainer stuff like putting the console in a common area of the house and even playing with the kids.

It's probably a little redundant to most Atomicans, but anything that helps parents do their job instead of relying on governments to do it for them is a good thing.

you said...

Krispy89: *"Just think if this got some Airtime on Sunrise or Today, those shows seem to get the message across to the more 'Mature' populous..."*

Yeah, but they give airtime to anyone these days! –ed.

FROM ATOMIC ONLINE

So it's that (slightly early) time of the month again, where we celebrate the very best posts made over the last month (or, more accurately, few weeks).

We're going a little early, for those that don't know, because Haymarket and Atomic is shutting down soon for the year, and subsequently we're sending this issue to the printers slightly early.

Anyway, on with the awesome-sauciest show! Our winner this month is no stranger to POTM, and a might fine part of the Atomic crew. It's...

Redhatter! For laying a very juicy cable... I mean, post! A post about cables!
http://forums.atomicmpc.com.au/index.php?showtopic=38137&st=0&p=766594&#entry766594

Whoo! But, he does not stand alone...

Lambo joins the roll of honor, with his paean to Lego.
http://forums.atomicmpc.com.au/index.php?showtopic=38198

hulkster pushes the community to put a stop to an important crime.
http://forums.atomicmpc.com.au/index.php?showtopic=38417

And **Xap** shares a little bit of herself with us.
http://forums.atomicmpc.com.au/index.php?showtopic=38444

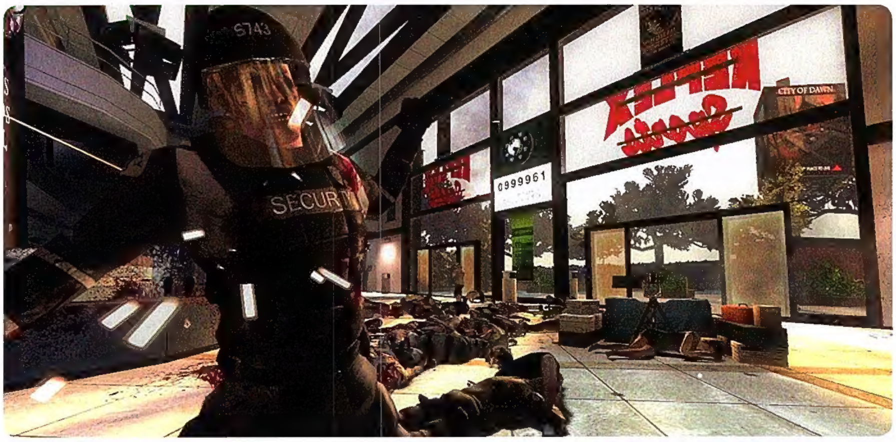
Brilliant stuff all round. As usual, our POTM winner will get some shiny new Razer kit - yay for free stuff!

POTM
WINS A RAZER IMPERATOR!

MODIFICATION with Ashton "One Mod To Rule Them All" Mills

Dead before Dawn

Game Left 4 Dead 2
URL www.moddb.com/mods/dead-before-dawn

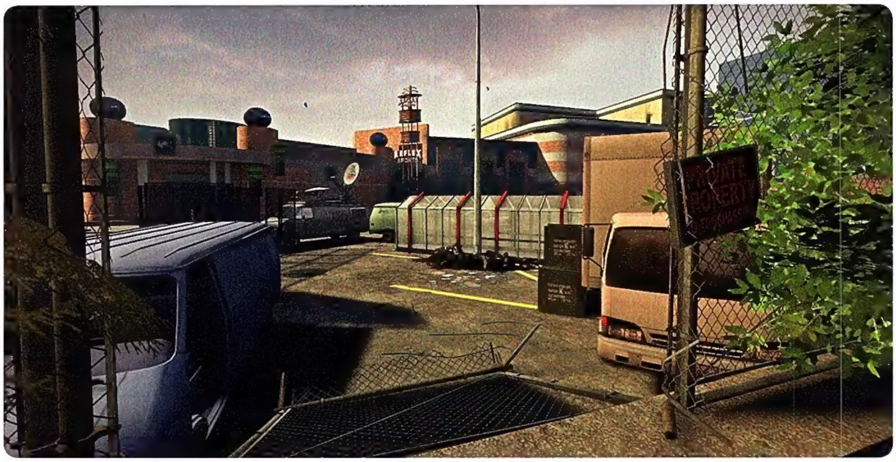


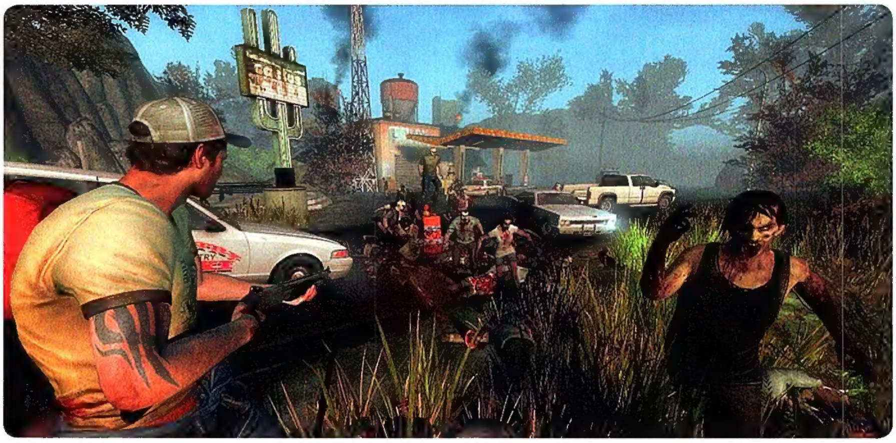
Hot off the presses this month... or at least the burning tarmac outside Cross Roads Mall... comes a mod all but destined to be made for Left 4 Dead 2: a playable remake of the defining Zombie movie of our time, Dawn of the Dead.

Modder Darth_Brush and his team have faithfully re-created the Cross Roads Mall and surrounding locations to let you play out the experience of being the last known surviving humans, mobbed by zombies intent on eating you alive.

Much more than just a map, Dead Before Dawn is a campaign that includes 300MB of atmospheric music, scripted events, new models and props. There's also another 200MB of professional voice-acting – primarily for a grumpy security guard called CJ, who will send you and your buddies on wild zombie hunts as you try to survive.

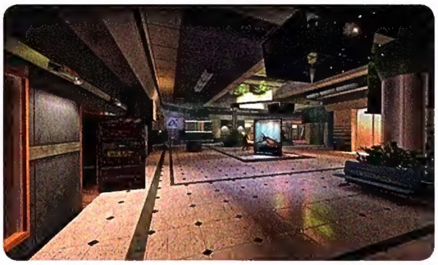
If there's one thing Dead Before Dawn nails it's the atmosphere created by Zack Snyder's 2004 version of the original film. From the music to the models and the maps, it's the closest thing you'll likely want (or not want!) to being there.





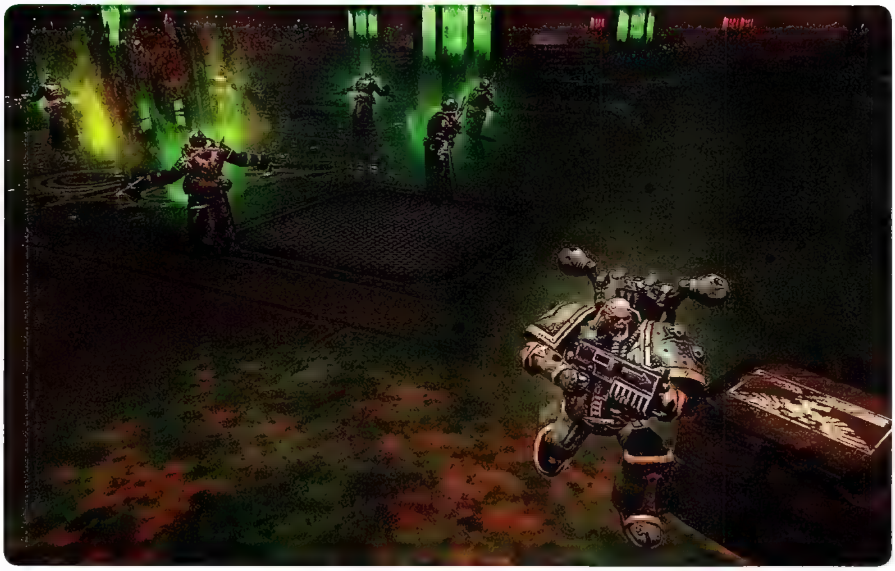
This release is actually an update of the original Dead Before Dawn mod for Left 4 Dead that won mod of the year in 2008 by ModDB. This version further builds and polishes on the original, but is still available if all you've got is L4D1. Otherwise, be sure to grab the Dead Before Dawn Too .vpk package for L4D2, that clocks in at just under 400MB.

If you love zombie movies and zombie games, get this.



Space Hulk

Game Dawn Of War II Chaos Rising
URL www.moddb.com/mods/space-hulk-mod



FOR THE EMPARAHHHHHHgrggghd... gghgh ghgh *cough* *wheeze*.

It's been a while for an old space marine to remember those tabletop games, playing Games Workshop's original Space Hulk boardgame.

But what do you get if take that venerable beacon of awesome and mix it with an up-to-date engine on the PC like Dawn of War II? Why, Space Hulk on the PC of course!

It is your job, as commander of the Space Marines, to eradicate – nay purify – the greatest threat to human kind since the beginning of xenophobic fears: the Genestealers.

You do this, of course, by entering a space hulk infested with xenos to systematically destroy them through a series of missions, each with unique objectives.

You can play on your own or with friends, each taking on a particular type of marine – melee, heavy weapon carrier, etc – in 'Space Hulk Reloaded' and defeat the enemy AI as a team or play the 'Original Space Hulk' mode where the board game is faithfully re-created: you play through the original twelve missions of the Sin of Damnation campaign and instead of a co-op mode, as with the board game, you and your pals play as either the Space Marines, or Genestealers. For Genestealers, a respawn mechanic ensures a constant supply of Genestealers with which you must prevent the marines completing their objectives.

PATCH notes

MapleStory Patch v93

Soul of Ultimate Nation S.U.N Global Patch v1.0.0.2_0.8 to v1.0.0.4_0.1

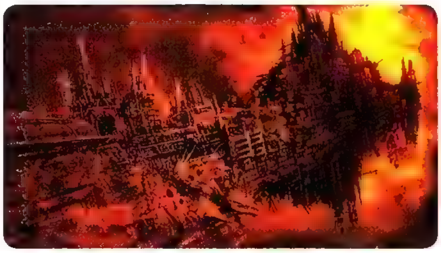
Enemy Engaged: Comanche Hokum Community Patch v1.13

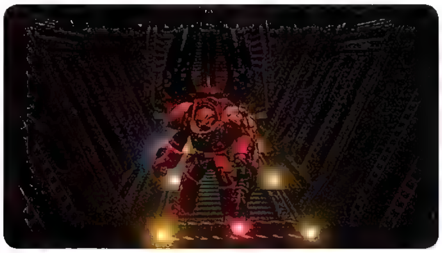
ArmA 2: Operation Arrowhead Patch v1.56

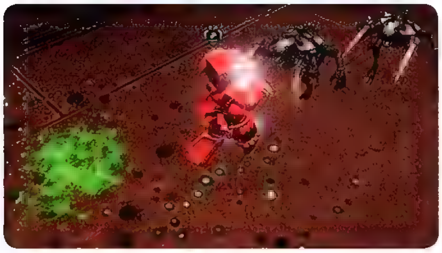
Battlefield Bad Company 2 Patch R10

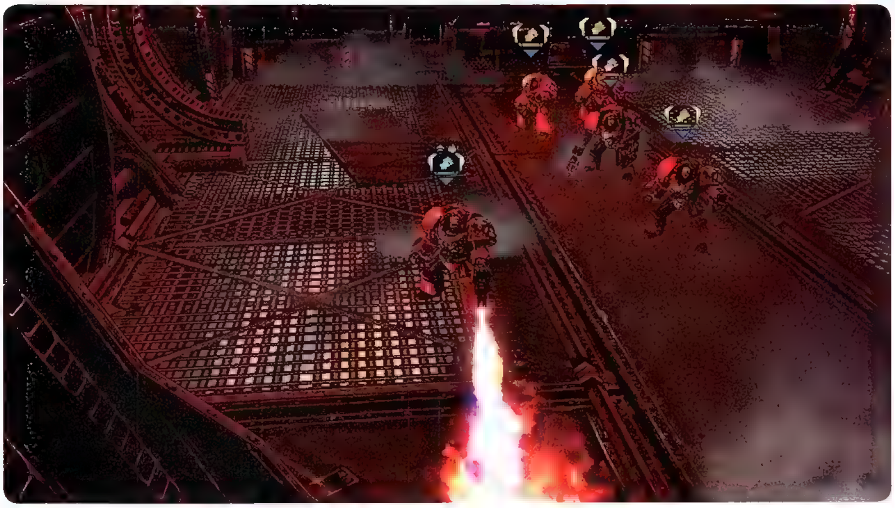
Need for Speed Hot Pursuit Patch #1 v1010

It's not immediately clear from the mod's homepage that this actually requires Chaos Rising, but it does, so you'll need to upgrade if you only have the original Dawn of War II. The mod is a relatively small download at 200M and if you get it – and if you're *any* sort of Warhammer 40k fan you'll love it – be sure to grab the latest release, version 1.3.0 at the time of writing.









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People often ask what we do in the Atomic offices all day, and until now the answer has been all sorts of boring things like 'insult each other', 'drink coffee' and occasionally 'review tech'. That has all changed. Now, what we do all day consists of one thing: quadricopter fighting.

It's the remote control car we crashed mercilessly as kids, re-imagined for the 21st century – so it flies and you control it with an iPhone or iPad. It's also equipped with two cameras, so you can send it out into the next room on fact-finding missions. Or just workmate-annoying missions. It's probably too noisy for full-on stealth attacks, but it's still way more fun than just insulting each other with words.

3rd Earth Multi-Seat Wireless

Price: $148 **Website:** www.bluemouth.com.au

Oh, car-racing. It's all about having both hands on the wheel, your feet crunching down on the pedals and your butt in a sleek – but possibly slightly uncomfortable – seat. Those who love it really love it, and they're the ones 3rd Earth had in mind when they designed this little set-up. So, if you are one of the many, many Atomicans out there who lined up for GT5, and you enjoy the uncomfortable seat experience and all that pedal-to-the-metal frippery, this one might be right up your alley.

Its biggest selling point? It's wireless, so you can set it up anywhere in the lounge room without worrying about tripping yourself up with cabling. Go, speed racer, go!

Aliens Pulse Rifle

Price: $US899.99 **Website:** www.thinkgeek.com

So … you got a whole lot of underwear for Christmas, again. You spent the day trapped in conversation with Weird Uncle Gary, who is amusing for the first fifteen minutes but gets more and more frightening as the whiskey bottle gets emptier and emptier. You got the driest bit of the turducken and had to sit at the kids table to eat it.

Well, don't despair. There are a whole three hundred and fifty-odd days until you have to do it all again. And if that's not good enough, maybe drop some of that Christmas cash on this 100 per cent faithful prop-replica M41-A pulse rifle. It's big and it's heavy and it's made of metal, so it's sure to make you feel better about all the indignities that were Christmas 2010.

Just don't go loaning it to Weird Uncle Gary…

WD TV Live Hub Media Centre

Price: $299.99 **Website:** www.westerndigital.com

Something terrible happened on the weekend. A member of the Atomic team went to stream some perfectly legally-acquired television from their computer to their big shiny HDTV, only to discover that the games console being used to facilitate the transaction did not support the codec in question. It was quite the tragedy. We're still getting over it.

If only we'd had a WD TV Live Hub Media Centre, this might never have happened. The Live Hub supports a whole mess of file formats and codecs, and you can either store your media on its 1TB hard drive or stream it from your PC – or even the internet, if that's more your thing. So no more rainy Saturday afternoons spent muttering under your breath about having to watch Battlestar Galactica in HD *on your laptop* like a loser.

Belkin Wrist-Fit

Price: $19.95 **Website:** www.belkin.com.au

You're really either a watch person, or you're not. But even if you are, chances are you sometimes long for something more interesting on your wrist than the time... like maybe a big chunk of your music collection and a whole mess of podcasts.

And that's why Belkin invented the Wrist-Fit – a nifty little gadget that turns your 6th-generation iPod Nano (not included, unfortunately) into something out of a classic 1970s Bond film. The strap is totally adjustable, so whether you have bony little girl wrists or big man limbs, you won't miss out.

And if you do need to know the time, Belkin are pleased to let you know that the Nano (still not included) does that too. Win!

Jaybird Sportsband Bluetooth Headphones

Price: TBC **Website:** www.audion-mm.com

The thing with audio headgear is that form has always followed function. This isn't a bad thing, as such, but makes them pretty boring, design-wise – you have two earcups, linked by a band of metal or rubber or both, and a cord coming out one end to connect your head to your device. It's so standard it's actually an international symbol.

…and there's nothing wrong with that, but it doesn't mean there's not room for something different. Such as the Jaybird Sportsband.

First off, it does away with the cord, grabbing all your tunes by way of Bluetooth. And then, it integrates the earcups into the headband for a very cool unibody design. Finally, it comes in nine wacky colours, including 'toffee-apple red', pictured, 'limonade green' and 'polar blue' (also 'powder-puff pink', if you're wondering). Traditionalists may prefer 'midnight black', but we like that we have the option to go garish if we want to.

We also like that they come with a lifetime warranty against sweat damage, so we've got the headgear ready to go should we ever decided to get into that whole 'exercise' thing.

The Browser Wars!

Jake Carroll pulls back the online curtain and finds out what makes your browser tick.

Catching up on the latest tech gossip online is as common as brushing your teeth. Sadly, for some of us, it's more common. One might go so far to say that browsing the Internet is the very archetype of our modern world. This month, we're dumping a can of paint stripper over your desktop and taking a close look at something that is ubiquitous, elegant and very much an essential tool in our modern lives. We're going to X-Ray the humble Web Browser.

Ego has landed

Modern web browsers aren't actually that humble. They are complex beasts made up of years of developmental efforts and research. One of the things we normally do in X-Ray is go through the history of a technology before diving into the current day incarnation. This month, there's a little too much present day innovation for too many 'version 1.0 of IE' style reflections.

That CERN guy

Most analysts consider Sir Timothy John 'Tim' Berners-Lee to be the father of the World Wide Web. The Web was defined as his creation, as he was the first individual to propose the HTTP protocol interacting with a server in 1989. On Christmas day in 1990, he gave CERN the gift of the first HTTP connection from a client computer to a server; displaying some text and images in a browser he called WorldWideWeb (with stunning imagination and creativity). Effectively, this was the beginning of the Web that we know, love, and hate.

What is the WWW?

So prevalent is the acronym 'WWW', yet it's also misunderstood and ill defined. Dereferencing the Internet from this (being a global system of computers interlinked via networks, with a common protocol), we're left with the stuff that sits 'on top' of the Internet. The WWW, as it is presented to us on a screen through a web browser could be defined as a series of client/server interactions that result in text, graphics, content and media being rendered to a standard on a page, in our preferred applications.

1. From the browser, a server-name portion of a URL is resolved into an IP address using what we all know as DNS (Domain Name Server).

2. The browser requests a resource by sending an HTTP request to the web server at that particular address. In the example of a normal web page, the HTML text and components of the page are parsed first, along with some specific tags, which then make requests for additional resources required to format and display the page correctly.

3. In the process of receiving these files and resources from a web server, browsers have the ability to progressively render pages as per the HTML specification, Cascading Style Sheets (CSS) or other composition tools.

Structure of the URL

If you've ever wondered why some sites have a 'www' at the beginning of their address, and some don't, the legacy came from naming Internet hosts after the service that the host provided. ftp for FTP, nntp for USENET, or ntp for an internet time server. As many web engineers and developers will attest to, the 'www' as a subdomain isn't actually required by any technical or policy standard. As it turns out, the very first web server was called nxoc01.cern.ch. Plenty of sites continue to exist without 'www'.

The 'http' part of the equation defines the communication protocol to be used for the request and response. The astute will have realised a long time ago that many browsers are capable of using http://, ftp://, afp:// and other protocols in the URL bar.

Browser guts

People have a tendency to religiously believe in their browsers' supremacy above all others for one reason or another. It's time to pull apart some browsers to see what differentiators exist, if any, to justify this allegiance.

The chaos engine

The engine is a software component that parses the marked up content in a web page, along with all the formatting information (CSS, XSLT) and subsequently displays the formatted content to the user in the web browser window. The functional differences behind each of the competing browsers' layout engines is significant, but in reality, what we experience as end-users could arguably be considered similar across all platforms. Web engineers and developers will scream at such a statement – so yes, we are cognisant of cross browser behavioural issues!

In the elder days, web browsers were monolithic because the layout engine and the web browser application itself were one slab of code. These days however, things are far more modular. Think of it as the difference between a modular PSU and a non-modular unit. With one, you can plug in the appropriate rails and cables to power almost anything inside your case, making it effectively more useful, less cluttered and more flexible. With the other, what you see is what you're stuck with.

The modular engine as we know it today does 95 per cent of the work involved in giving the user a web browsing experience. It parses the URL and then takes the composition of the 'rectangle' we perceive to be the viewing window in our web browser as core arguments. In a simplification of the process, the engine then retrieves the associated content reflected by the <tags> and <markup> to paint a graphical representation inside the viewing rectangle.

The user interface

Wrapped around the outside of the viewing rectangle are the boring but highly functional bits we all put up with. File menus, navigational buttons and context input handling command tools. Interestingly, because the user interface provides the control and graphical elements that surround the area the engine paints or renders, it is often called 'chrome'. We can only assume this is what Google were alluding to.

Funny terminology

We need a little clarification, as it's an oft-confused term: 'layout engine' and 'rendering engine' are terms commonly used to generically explain a web browser engine, collectively. We have to be careful here, however, because their traditional meanings are quite different. The **layout engine** is the software module and component that computes the position of markup-parsed objects within the context and subject to various constraints. Web browser engines contain a page layout module to determine the position of elements on a page.

A **rendering engine** is the software component that transforms graphical objects into a raster representation. All prominent web browser engines include a module that can transform bitmap and vector graphics, as well as text, onto your viewing rectangle. Within that, what you're seeing represented in your web browser as an image might be something you can 'save' as a JPEG or TIFF – but the reality is, when it's rendering in real time onto your screen, it's going through a rasterisation process.

http://en.wikipedia.org/wiki/Raster_graphics

To illustrate how the different browsers parse image data, we've taken the source code for their image rasterisation and translation engine modules and isolated the basic C++ that is pertinent to making things render.

In Mozilla FireFox, the appositely named "libpr0n" source is one of the two libraries responsible for rendering and parsing of graphics as well as bringing in other helper libraries to get data from a remote server, to your screen, looking like it should.

```
#include “nsImgBuildDefines.h”
#include “nsIDeviceContext.h”
#include “mozilla/ModuleUtils.h”
#include “nsXPCOMCID.h”
#include “nsServiceManagerUtils.h”
#include “RasterImage.h”

#undef LoadImage

#include “imgLoader.h”
#include “imgRequest.h”
#include “imgRequestProxy.h”
#include “imgTools.h”
#include “DiscardTracker.h”
```

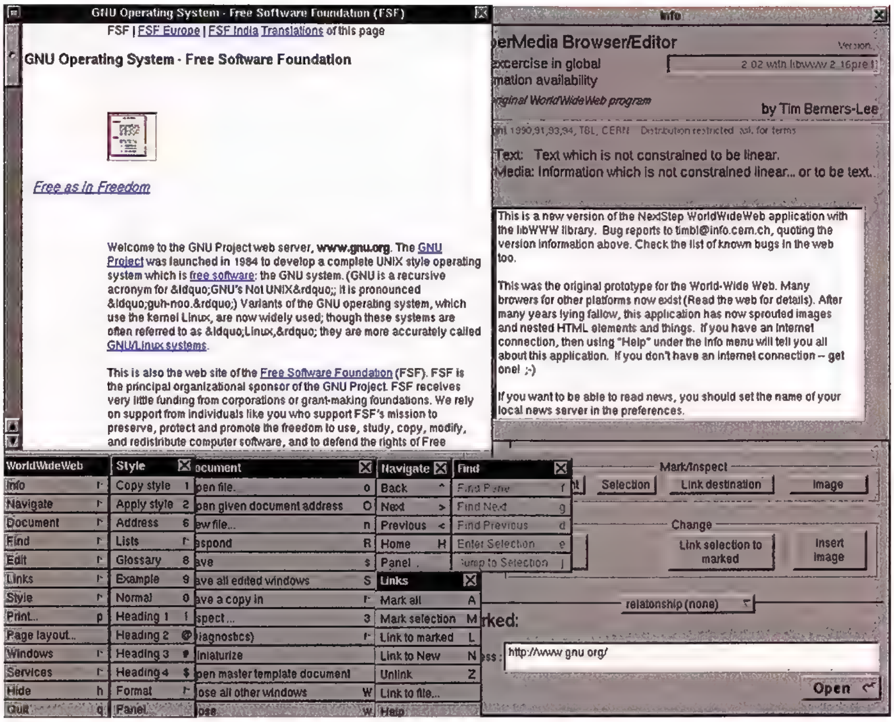
```
  #ifdef IMG_BUILD_ENCODER_png
  // png
  #include “nsPNGEncoder.h”
  #endif
  #ifdef IMG_BUILD_ENCODER_jpeg
  // jpeg
  #include “nsJPEGEncoder.h”
  #endif

  // objects that just require generic
constructors
  namespace mozilla {
  namespace imagelib {
  NS_GENERIC_FACTORY_
CONSTRUCTOR(RasterImage)
  }
  }
  using namespace mozilla::imagelib;

  NS_GENERIC_FACTORY_CONSTRUCTOR_
INIT(imgLoader, Init)
  NS_GENERIC_FACTORY_
CONSTRUCTOR(imgRequestProxy)
  NS_GENERIC_FACTORY_
CONSTRUCTOR(imgTools)

  #ifdef IMG_BUILD_ENCODER_jpeg
  // jpeg
  NS_GENERIC_FACTORY_
CONSTRUCTOR(nsJPEGEncoder)
  #endif

  static const
mozilla::Module::CategoryEntry
kImageCategories[] = {
    { “Gecko-Content-Viewers”, “image/
gif”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
jpeg”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
pjpeg”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
jpg”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
x-icon”, “@mozilla.org/content/
document-loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
vnd.microsoft.icon”, “@mozilla.org/
content/document-loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
bmp”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
x-ms-bmp”, “@mozilla.org/content/
document-loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
icon”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
png”, “@mozilla.org/content/document-
loader-factory;1” },
    { “Gecko-Content-Viewers”, “image/
x-png”, “@mozilla.org/content/document-
```



GNU Operating System - Free Software Foundation

Free as in Freedom

Welcome to the GNU Project web server, **www.gnu.org**. The GNU Project was launched in 1984 to develop a complete UNIX style operating system which is free software: the GNU system. (GNU is a recursive acronym for &ldquo;GNU's Not UNIX&rdquo;; it is pronounced &ldquo;guh-noo.&rdquo;) Variants of the GNU operating system, which use the kernel Linux, are now widely used; though these systems are often referred to as &ldquo;Linux,&rdquo; they are more accurately called GNU/Linux systems.

This is also the web site of the Free Software Foundation (FSF). FSF is the principal organizational sponsor of the GNU Project. FSF receives very little funding from corporations or grant-making foundations. We rely on support from individuals like you who support FSF's mission to preserve, protect and promote the freedom to use, study, copy, modify, and redistribute computer software, and to defend the rights of Free

erMedia Browser/Editor

Version

2 02 with libwww 2 16pre1

xcercise in global
mation availability

iginal WorldWideWeb program

by Tim Berners-Lee

ht 1990,91,93,94, TBL, CERN Distribution restricted. ask for terms

Text: Text which is not constrained to be linear.
Media: Information which is not constrained linear... or to be text.

This is a new version of the NextStep WorldWideWeb application with the libWWW library. Bug reports to timbl@info.cern.ch, quoting the version information above. Check the list of known bugs in the web too.

This was the original prototype for the World-Wide Web. Many browers for other platforms now exist (Read the web for details). After many years lying fallow, this application has now sprouted images and nested HTML elements and things. If you have an internet connection, then using "Help" under the Info menu will tell you all about this application. If you don't have an internet connection – get one! ;-)

If you want to be able to read news, you should set the name of your local news server in the preferences.

WorldWideWeb Browser, running on NeXTSTEP platform.

```
loader-factory;1" },
    { "content-sniffing-services", "@
mozilla.org/image/loader;1", "@mozilla.
org/image/loader;1" },
    { NULL }
  };
```

Here we see the core of exactly how Firefox determines how it will render content, and the techniques it uses to select the plugins it will require to render each image type.

nsImageLoader manages the image loads occurring for a page load. It hands out image request proxies through your Internet connection over HTTP when needed. **nsImageRequest** checks the image cache for matches and manages call backs when a match is found. **nsImageContainer** is a box for image or animation content. It owns the frames of an animation, the colour space information and the timing for display. **nsImageDecoderObserver** is responsible for the feedback needed to tell a user what percentage of a page has loaded. Without it, we'd never know!

We thought we'd demonstrate the behind the scenes nature of the engine, and just how hard it works. We can exemplify this by looking at yet another one of the Firefox libraries, known as nsJPEGDecoder.cpp. This file contains the methodology used to take a JPEG file from a request, and turn it into something useful:

```
  /* Colorspace conversion (copied from
jpegint.h) */
  struct jpeg_color_deconverter {
    JMETHOD(void, start_pass, (j_
decompress_ptr cinfo));
    JMETHOD(void, color_convert, (j_
decompress_ptr cinfo,

JSAMPIMAGE input_buf, JDIMENSION input_
row,

JSAMPARRAY output_buf, int num_rows));
  };

  METHODDEF(void)
  ycc_rgb_convert_argb (j_decompress_
ptr cinfo,
                   JSAMPIMAGE input_buf,
JDIMENSION input_row,
                   JSAMPARRAY output_
buf, int num_rows);
  }
```

And from here, it drills down to the efficiencies of rendering. For example – have you ever wondered why some images load all at once, and some load progressively, as if the pixels were being loaded in 'chunks' ?

```
        // copy pixels in blocks of 4
        while (idx >= 4) {
          GFX_BLOCK_RGB_TO_
FRGB(sampleRow, imageRow);
          idx        -=  4;
          sampleRow += 12;
          imageRow  +=  4;
        }
```

Such examples of complex algorithms for every facet of rendering a page (we hope) give you a better understanding of just how much takes place, and how hard your computer is working to actually render a web page. It just so happens that with all the multi-core love we have these days, compiled C and C++ binaries fly through the pipeline quite readily. That isn't to say, however, that it's an insignificant task!

To illustrate just how different the rendering and layout engines can be (and in that, getting to the crux of our browser war), we took some other open source code that has the same net effect and found the core content renderer again. This time, we used WebKit, and jump into the WebImage.cpp:

```
  #include <CoreGraphics/CGImage.h>
  #include <wtf/PassRefPtr.h>
  #include <wtf/RetainPtr.h>

  using namespace WebCore;

  namespace WebKit {

  WebImage WebImage::fromData(const
WebData& data, const WebSize&
desiredSize)
  {
      // FIXME: Do something like what
WebImageSkia.cpp does to enumerate
frames.
      // Not sure whether the CG
decoder uses the same frame ordering
rules (if so
      // we can just use the same
logic).

      ImageSource source;
      source.setData
(PassRefPtr<SharedB
uffer>(data).get(),
true);
      if (!source.isSizeAvailable())
          return WebImage();

      RetainPtr<CGImageRef>
frame0(AdoptCF, source.
createFrameAtIndex(0));
      if (!frame0)
          return WebImage();

      return WebImage(frame0.get());
  }
```

WebKit isolates functions and manages its methods of frame isolation and the painting of the web browser rectangle with more granularity than FireFox, but does so with some more complex data structures and operations.

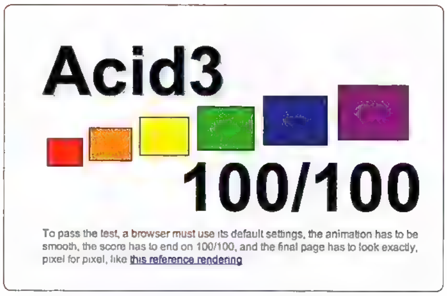
```
  #include "config.h"
  #include "WebImage.h"
  #include "Image.h"
  #include "ImageSource.h"
  #include "NativeImageSkia.h"
  #include "SharedBuffer.h"
  #include "WebData.h"
  #include "WebSize.h"
  #include <wtf/OwnPtr.h>
  #include <wtf/PassRefPtr.h>

  using namespace WebCore;

  namespace WebKit {

  WebImage WebImage::fromData(const
WebData& data, const WebSize&
desiredSize)
  {
      ImageSource source;
      source.setData
(PassRefPtr<SharedB
uffer>(data).get(),
true);
      if (!source.isSizeAvailable())
          return WebImage();

      // Frames are arranged by
decreasing size, then decreasing bit
depth.
      // Pick the frame closest to
|desiredSize|'s area without being
smaller,
      // which has the highest bit
depth.
      const size_t frameCount = source.
frameCount();
```



To pass the test, a browser must use its default settings, the animation has to be smooth, the score has to end on 100/100, and the final page has to look exactly, pixel for pixel, like this reference rendering

Acid3 running to completion with a 100/100 score in Chrome.

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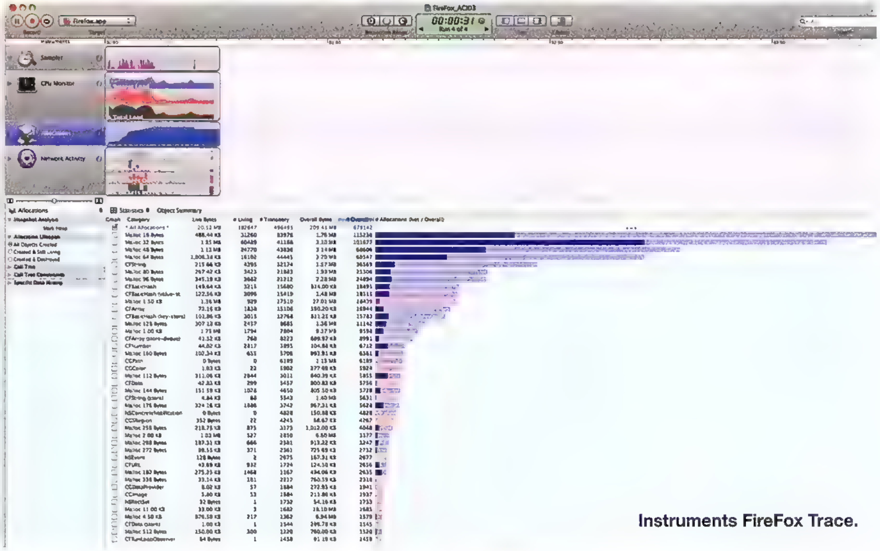
2X Copper PCB



Instruments FireFox Trace.

```
      size_t index = 0;  // Default to
first frame if none are large enough.
      int frameAreaAtIndex = 0;
      for (size_t i = 0; i <
frameCount; ++i) {
          const IntSize frameSize =
source.frameSizeAtIndex(i);
          if (WebSize(frameSize) ==
desiredSize) {
              index = i;
              break;  // Perfect match.
          }

          const int frameArea =
frameSize.width() * frameSize.height();
          if (frameArea < (desiredSize.
width * desiredSize.height))
              break;  // No more frames
that are large enough.

          if (!i || (frameArea <
frameAreaAtIndex)) {
              index = i;  // Closer to
desired area than previous best match.
              frameAreaAtIndex =
frameArea;
          }
      }

      OwnPtr<NativeImageSkia>
frame(source.createFrameAtIndex(index));
      if (!frame.get())
          return WebImage();

      return WebImage(*frame);
  }
```

Here, we see the mathematics and functional statements needed to lay the image on the page.

Equality in browsers

All browsers are not equal in capability, performance or efficiency. It's a leapfrog effect, not dissimilar to the war between the GPU vendors. One day, AMD will whack 50,000 more transistors onto a die, and add another 512 stream processors. A week later, nVidia will add another 100,000, bump up the core clock, and add some more instructions. One of the means to determine the capability of a browser's layout and rendering engine to correctly interpret layout information is the Acid3 testing regime – recognised as a useful benchmark for checking the javascript compliance of an engine, amongst other capabilities such as content style sheet rendering awareness.

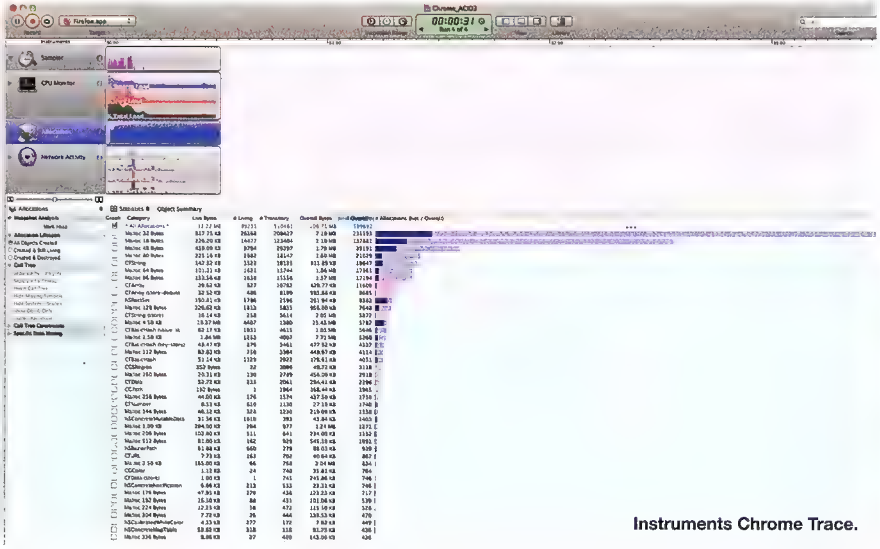
Going deeper, we can actually dig around, if we're cunning enough, to learn about the overall impact different browsers have on our computers and explain a little bit more about the efficiency of the software itself. We used Safari, Chrome and FireFox on a MacBook Pro running Snow Leopard, 10.6.5 with 4GB of DDR3 RAM, with a core clock of 2.4GHz (C2D), and ran the Acid3 test while performance profiling the process ID of the browser using Sun-Oracle's D-Trace diagnostics tools. To stop mind melt, and to make it a little more accessible for everyone, we used Apple's built in 'Instruments' as the graphical front end to D-Trace. Interestingly, Instruments used to be called 'X-Ray'.

We begin to understand just how differently a browser can behave, depending upon rendering engine and layout engine.

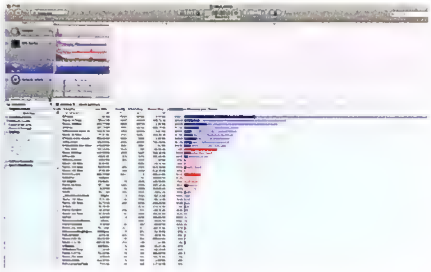
If we look at the overall allocations metric, we see Firefox running less efficiently, making more memory calls overall and ballooning with a larger memory footprint than Chrome or Safari. With a 209.41MB allocation footprint, it's by far the busiest memory-hitter browser in this group. Safari and Chrome behave similarly in malloc (memory allocation) calls, which is unsurprising, considering they both use the same WebKit layout and rendering engine. Chrome misses out on being the most efficient browser on this particular platform because of a few small things that aren't obvious. Safari, built for Mac OS X, benefits from a few system calls that make things cleaner and easier to achieve natively, hence, it can get away with a ~50MB set of allocations, rather than Chrome's ~100MB set. The next time you see an inflammatory article about ABC browser being 'more efficient' than XYZ browser, you might just know better.

A long road it's been for the web browser. It's taken years of refinement and work to come to this amazing point that we all appreciate and simultaneously take for granted. The next time you open up a browser, we'd encourage you to stop and take a minute to think about exactly what it's doing, and marvel at the complexity of its seemingly trivial task. You probably won't look at the web the same way ever again.

Or at least for a little while.



Instruments Chrome Trace.



Instruments Safari Trace.

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Kingston TECHNOLOGY

INPUTOUTPUT

Dan Rutter brings the answers to your questions like no-one else can.

I/O OF THE MONTH

Battery building

I I bought a used laptop. The battery was dead. I cut it apart and found out what sort of lithium ion cells it used and bought six more of them on eBay. I stuck those cells together with wire and sticky tape and Blu-Tacked the wires into the gutted battery shell and verified that the laptop would charge them and run from them. Yay me.

So now I need to solder the cells together with little bits of wire so I can stuff them back into the battery casing.

How the hell do you do that? The solder doesn't stick! Do I need a special soldering iron? Can you only connect these cells with the little factory welded tab things?

Alana Jarman

O Any electronics soldering iron (so, not a huge plumbing iron; a 25-watt eBay cheapie will work fine), with a chisel tip on it (not a point), will work for soldering battery cells. You may have trouble getting cells with folded wire between them to fit where cells with thin spot-welded tabs were before, but the soldering, at least, is not hard.

The secret is to scratch up the ends of the cells. Sandpaper, a Dremel grinding bit, the corner of a file; anything that roughens the surface. Now you should be able to easily 'tin' the end of the cell almost as soon as you touch iron and solder to it, then press the similarly-tinned wire onto the end of the cell with the iron, remove the iron, and hold the wire still until it's stuck. Done.

If the solder doesn't flow over the surface pretty much instantly, you're doing it wrong. It's easy to overheat and damage the cell this way. Practice on cheap *non-rechargeable* batteries – old flat ones, if you're especially nervous – until you get the technique down.

I/O OTM

WINS A THERMALTAKE CHALLENGER PRO KEYBOARD

Of all the things I've taken pictures of for this column, this is definitely one of them.

Cool, but furry

I I felt like a suuuuper genius when I upgraded my computer's cooling for summer by removing the faceplates for all of the unused 5.25-inch bays and making room for a quiet but powerful 140mm fan in the front. Every temperature reading dropped by 15 degrees. No more mid-game CPU speed throttling!

But now, of course, there aren't just dust bunnies inside my PC. More, dust wombats.

Okay, I'm an idiot for not putting a dust catcher on the front of the new fan hole. But now I can't find the right sort of filter foam to put there. The hole's too big for 80 or 92 or even 120mm fan filters, even if I had some way of mounting one there. What should I do?

Joseph Gale

O Try flyscreen.

Fine flyscreen won't catch really tiny dust particles nearly as well as normal dust filters, but you'll find it'll catch quite a lot of stuff – especially pet hair, if that's an issue.

Failing that, there are free-flowing filter materials that come in large sheets, for use in heating, ventilation and air-conditioning (HVAC) applications. They're quite cheap , but you may need to call around a bit to find a supplier. Try starting with your local air-con installer.

A strapping lad

I Okay, so if I want to work on my computer without buying a ticket in the Wreck Your Hardware Lottery, I need an anti-static wrist strap. Got it.

I'm looking on eBay for them, and they're dirt cheap, so that's great – but there are two kinds.

One kind has a curly cord going from the Velcro strap to an alligator clip and/or banana plug. But the other kind is 'wireless' or 'cordless', with just a little metal stud or screw sticking out.

That certainly sounds more convenient. How does it work? Corona discharge?

Marc Welsh

O Cordless anti-static wrist straps do not actually work at all. Like the mobile-phone antenna-booster sticker, and the performance-enhancing magic sports bracelet, they are pure placebo.

Cordless straps can actually do harm, as you think you're protected when you're not. It's better to use the standard half-assed anti-static precautions (leave computer plugged into the wall so its chassis is earthed, and touch the chassis periodically) than to use a placebo.

Proper wrist straps aren't much less convenient, by the way. Even the cheapest versions usually have the cord attached to the strap with a metal press-stud, so you don't have to remove and replace the actual strap every time you move away from the computer.

To enjoy the full cordless-strap experience, just forget to reconnect the cord when you come back!

Single point of power

I Can I run a number of 12V devices from a single AC adapter?

Presently I have three devices each with their own AC adapter putting out 12V between 0.5A-2A. If I found an appropriate AC adapter (maybe a 3A or 4A adapter) could I just split the output from the one adapter to all of the various devices?

And will running a device using a correct voltage adapter but with a higher than originally specified current cause any problems?

(If you're wondering, the devices are modem, 8-port gigabit switch, and a dual band wireless AP – and yes I know that you can get a single integrated device that almost does all of the above.)

James

O Yes, you can. It's conceivable that one of the devices will do something like emit noise down its power lead that one of the other devices won't like, but it's very unlikely.

Herewith, the ways in which you can get this wrong:

1. Using an unregulated power supply, that gives more volts when it's not fully loaded. Unlikely these days, since most off-the-shelf AC adapters are lightweight switchmode regulated units, but perfectly possible if you fish some dusty old power supply out of a bits box. If in doubt, stick a multimeter across the '12V' output with the power supply unloaded. A small amount of variation – say, 11V to 13V – is unlikely to be a problem, but a lightly-loaded unregulated '12V' supply can deliver more than 16V.

If the voltage is regulated, it doesn't matter how excessive the current capacity a power supply is, for analogous reasons to those that protect you from the entire contents of your municipal water tower blasting into your kitchen when you turn on the tap.

2. Getting the polarity wrong. Most gear these days uses barrel-plug connectors with inside-contact positive, outside-contact negative, but don't make assumptions. Or, of course, mix up the wires when you're making your new multi-header power lead.

3. Overloading the power supply. As you say, you should add the power ratings of the existing devices to get the amperage spec for the new power supply. Then I'd add about an amp for comfort.

Read the power specs off the labels on the devices, if they have them, rather than reading the labels on their plugpacks. The peak specified draw of a device may be rather less than the maximum rating of its plugpack.

You're probably still going to need more power than any standard regulated plugpack can deliver, so I'm tempted to suggest you use a dirt cheap 'universal laptop PSU' off eBay for this job, but quality-control on those is pretty awful, so it's a bit of a lottery.

Good electronics stores should have a solid 12V unit to suit your purposes for around $50, like this one from Jaycar: **bit.ly/jaycarpsu1**

Proper industrial PSUs don't cost much more: **bit.ly/jaycarpsu2**

You could also use just the 12V output of an old PC PSU (the yellow wire on the drive-power plugs). Loading just one rail of a PSU used to be a bad idea, but even cheap modern PSUs are generally fine with that, and they'll barely notice a few-amp load anyway.

Clan laser projectors, or Inner Sphere?

I Now that red, green and blue laser pointers exist, there must be full colour laser video projectors too, right?

I understand that laser projectors don't need focussing, because the beams don't spread out. They're like an old CRT monitor, just scanning a coloured dot over whatever you point them at.

So why doesn't anybody sell them?

Are they only good for old-fashioned vector graphics? Can they only draw narrow bright scanlines with dark gaps in between? Do they blind you if you look down the barrel? What's the problem?

O. O'Bryan

O Actually, you *can* buy a laser video projector today. It'll just be one of those pocket-sized low-brightness 'micro-projectors', whose reason for existence is unclear.

Most of the world's laser projectors are indeed vector-graphics units, because they're one- or two-colour disco-lights. But full-colour raster-graphics laser video projectors do exist.

Because you can tweak the 'collimation' of a laser beam, it's easy to make a laser video projector's output no more scan-line-y than that of an old-style heavyweight CRT projector.

Industrial-scale laser projectors can definitely be a serious eye hazard, but because 1000 separated one-millisecond exposures to laser light are much less dangerous than a single one-second exposure (the fluid in your eye sinks the heat away from the retina, given a chance), a domestic laser projector with the same image brightness as a conventional projector isn't any more dangerous.

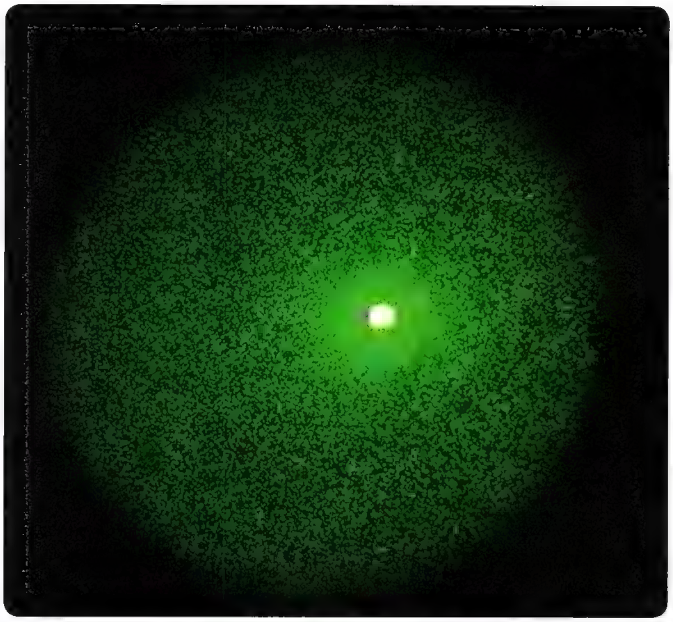
The problem, rather, is speckle patterns.

To save space on this page, I'll wait while you read the Wikipedia article about speckle patterns. Essentially, you'll see speckle whenever laser light – including light from the pocket-sized laser micro-projectors – bounces off something. And it's rather distracting. Never mind your DLP 'rainbow effect' or LCD 'screen door'; speckle won't go away even if you deliberately *unfocus your eyes*!

Domestic laser projectors remain a really cool idea, though, so there's a lot of work going into speckle-reduction. Multi-angle illumination, spinning diffusers, *vibrating screens*; the list goes on. Mitsubishi already make a staggeringly expensive laser-rear-projection TV that uses these tricks.

So one day, you'll be able to alarm your suburb with *Dead Space 3* projected onto low cloud.

I wouldn't hold my breath, though.



Speckle patterns are quantum physics made visible. Annoyingly visible.

The Conversation

Ashton Mills introduces the newest member of the family.

Recently I was looking at my PC – an E8600 @ 4.2GHz, 4GB RAM, dual GTX 280s and a pair of Raptors – with the case side off, cables spilling out and dust bunnies playing in the fans, and I realised. Perhaps it's coming to that time.

But first: The Conversation.

So I sat my girlfriend down and said I had something important to tell her.

"Honey" I said, looking her in the eye, "there's going to be a new member of the family soon."

Her mind raced with the possibilities. What could it be? I mean, *she* wasn't the one making the announcement, so it wasn't *that*. But was I talking of an adorable puppy or kitten? Her eyes lit up and she started to smile.

> I told a tale tall and true, of the great cycle of computer life from researching to buying to building ...

Sensing this perhaps *alternative* interpretation, I quickly got to the point. "No, no" I said, "something *much* better!"

Her smile turned to a frown, and she looked at me quizzically. Taking her hand in mine, I explained that a great event was near, a rite of passage among geeks, a special and sacred time that all of us go through.

I was upgrading.

"Soon you will hear the pitter-patter of tiny fans!" I said excitedly. She waited, as if it was something I had to explain. Hmmm, so I did.

I told a tale tall and true, of the great cycle of computer life from researching to buying to building; about growth, geekery, benchmarking and gaming, and that thrill of exploring new overclocking frontiers. Followed by the feeling of parent hood. A new machine. A new baby.

I went on to cover all the pertinent topics: why the perfectly-adequate computer in her eyes was no longer fit to the task, that no, it wouldn't be a big ugly thing like that stonking great TV in the lounge room, yes it probably would cost enough money to fund a small African nation, and that despite my clearly evocative description of its potential (granted, I did say things like "monolith of pure unadulterated power" and "a singularity of awesome") it would not one day go all Skynet on us. At least, not intentionally.

She looked at me, either with angle to affection or a consideration that I was perhaps mad, I'm not entirely sure. But I didn't notice, I was on a roll.

I further described what I was intending to get, using phrases like "smooth curves", "buxom facade" and, simply, "beautiful". She might have gotten jealous if she didn't know I was talking about a PC. Finally, I delved into the specifications, with CPU-power this and GPU-power that, gigaoodles of drive space and megamunches of memory – it was all silicon Greek to her, though, and she just waited until I had finished. Apparently, there was something I forgot. Above all of this, top of her mind, wasn't so much that we'd have a new member of the family, but more a question of just what impact this would have on my time. My passionate description of the PC probably didn't help.

"It sounds great" she says, leaning over. "As long as you don't forget about something"

"Uh, what's that?" I say, somewhat oblivious.

Raising a finger she points at herself, eyebrow raised, and smiles sweetly.

"Ah!", I proclaim, finally getting the hint "Well *of course* you're still number one honey! I mean, that goes without saying!"

Um, heh...

What did I get?

- Core i7 980x
- EVGA Classified 3
- 6GB g.skill PC-2000 CL6
- 2TB WD Caviar Black
- 2 x Crucial C300 128GB SSDs
- 2 x GTX 580 for SLI
- Auzen Hometheatre HD
- Corsair AX-1200
- Raven RV02 Evolution

Monitor undecided. Surround is tempting, but an ideal setup doesn't exist yet. More on this later...

Got some news of your own to break?
amills@atomicmpc.com.au

Antec 25

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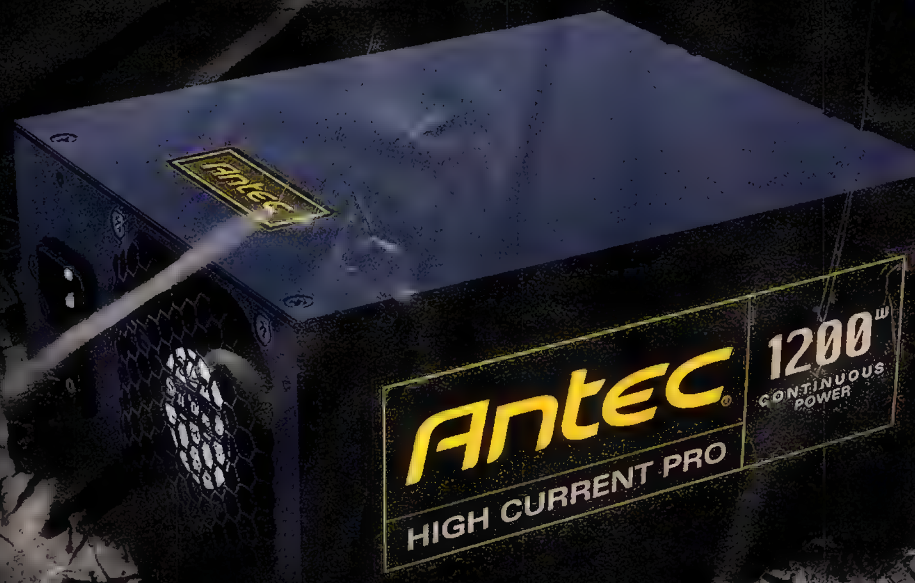

Antec High Current Pro 1200W

Where Raw Power Meets Unrivaled Performance

Sure, a quality power supply won't boost your fps, abolish bottlenecks, or slash your boot sequence, but Antec's High Current Pro 1200W PSU provides your high-end hardware with the power foundation it needs to take your computing experience to the next level. Antec's High Current Pro power supplies are designed with users who demand the best in mind and are 80 PLUS Gold certified to offer up to 92% efficiency. The HCP-1200 can deliver 99% of its rated power to its eight +12V rails.

The HCP-1200 has features you don't find on an ordinary PSU, including dual double-layer PCBs and heavy-gauge 16 AWG wiring capable of maintaining stable current and lower conducted resistance. Other components that give this PSU an edge over others include durable Japanese capacitors, a double-ball-bearing fan, gold-plated connectors, a DC-to-DC VRM, and a PWM fan controller for low acoustic noise and optimal cooling under load. This PSU also features a high-quality EMI filter, which eliminates noise from other nearby electronic devices.

Antec's advanced hybrid cable management system gives you the best of both worlds, combining a modular PSU's ease of cable routing and improved airflow with a traditional non-modular PSU's low wire-transmission loss. If you have any doubt about this unit's hardware capabilities, consider that FOUR of those +12V rails, supporting up to 30A each (up to 99A in total), are dedicated to graphics cards; there are eight 6+2-pin PCI-E connectors capable of supplying juice to your choice of up to quad graphics sub-systems. And this unit is both SLI and CrossfireX certified. Here you'll also find two 8-pin CPU connectors for supplying dual processor workstations or servers. Antec's latest PSU also ensures your hardware is protected against short circuits, under-voltage scenarios, and surges in voltage, power, and current.

Antec has made a name for itself by delivering a top-of-the-line, no-holds-barred high performance family of power supplies, and the HCP-1200 is no exception. ■

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INTERNET KILLED THE VIDEO STAR

There's more digital media out there than ever before: **Harry Butler, Clive Webster** and **Tom Glenny** investigate the hippest ways to watch video on your TV.

Video-streaming websites such as YouTube and iView have moved our favourite programmes from their traditional home on the television to the even smaller screens of our PCs, laptops and even smartphones. Downloading video has become as popular now as downloading music, with TV episodes available for download before they've finished broadcasting. Film studios sell high-definition digital copies of films alongside Blu-rays. Legitimate video download services are now flourishing; you could argue that you don't even need a TV.

You'd be wrong to think this, however. Although the way that we obtain media has changed and diversified, it hasn't all been for the better. While watching a video of a cat falling hilariously into a cardboard box might be fine on a laptop or smartphone, when you want to enjoy a favourite movie or TV show, a quality big-screen home theatre setup and comfy couch still rules the roost. To quote director David Lynch: "If you're playing [a] movie on a telephone, you will never, in a trillion years, experience the film. You'll think you have experienced it, but you'll be cheated."

The problem is that transferring online video streams or downloaded content onto your HDTV is a lot more difficult than some manufacturers would have you believe. Unlike physical media such as DVDs or Blu-rays, which have set parameters and formatting restrictions, digital media can come from a hundred different sources in a hundred different codecs. It's a result of the open nature of the Internet – with huge numbers of competing formats and video download services now available – and it means that finding a single playback device for all your media is very difficult.

Aside from the minefield of codecs, enjoying your digital media is a lot more complicated than simply sticking a disc in a drive and pressing play. Large digital collections require an intuitive method of navigating your media quickly and smoothly. The experience needs to be at least as easy as plucking a DVD from the shelf – if not vastly superior due to the inherent advantage of having all your media in one archive, rather than spread across multiple shelves in different boxes.

With these factors in mind, we investigated four different ways of viewing media on your TV. Is there a balance of practicality, price and straightforwardness? Read on to find out.

Internet-enabled TV

Many TVs can already connect to the Internet and stream video from your PC, so could transferring downloaded video to a TV be as simple as attaching an Ethernet cable?

The world is currently talking about 'Smart TV', with companies such as Apple and Google preparing to launch devices that will no doubt connect to iTunes or YouTube, or both. Intel spent a significant portion of its recent Developer Forum discussing how to make televisions smarter. The giants of consumer electronics have been chipping away at the problem for a while already, with Sony, Panasonic, Samsung and LG Internet-enabled TVs (ITVs) available on store shelves, and more in the pipeline. This new breed of TV can connect to networks, talk to DLNA and UPnP media servers to stream video and audio, and they typically claim to have all the capabilities of a Home Theatre PC – without the fuss.

The typical advantage of an ITV is that it's usually quite simple to operate; it either has a feature, or it doesn't. There are no Windows Automatic Updates, drivers, codec installations or crashes. When a TV supports DLNA, you receive perfect iView streaming (as long as the ABC servers aren't overloaded). We performed most of our testing for these pages with a Samsung UE40C7000, and happily watched iView HD without spotting any glitches – none of the other solutions we looked at, bar the Home Theatre PC, could do this, so it's impressive that a 27mm-thick TV can handle it perfectly.

As with smartphones, Internet TVs rely on apps to deliver services, rather than unleashing the entire Internet into your living room. This is sensible, given that you only have a remote with which to control the TV rather than a keyboard and mouse. However, the apps available can be as bewildering as they are useful.

Modular and interactive-odular

For every iView and YouTube app (which most new TVs now have), there's a raft of terrible games and pointless junk. Having Google Maps on your TV might sound good, but it's useless without a keyboard. Sony's ITV technology offers gems such as a FIFA widget to relive sporting moments, and the Ford Models modelling agency app.

The other problem with this approach is that if your shiny new TV doesn't have an app or a widget for the service you want, tough luck. In the land of custom-built computers this is unacceptable – we're used to having full control over what we want to do, whether it's installing a video codec or modding a case for better cooling. However, if you take the ITV route, you're at the mercy of the whims of large companies – if Samsung and local TV stations don't want to roll out an app, you won't get an app.

You need to do some research before buying a television specifically for its media streaming capabilities. This adds yet another item to your must-have purchasing list; taking it beyond simply checking its connections and image quality. There's also the ever-thorny issue of codec support, which could be a significant factor if you've already amassed a large media library.

As well as checking which apps or widgets the TV provides, you'll have to check which video codecs and containers it supports. This might not be so important if you don't have many videos already encoded, but you still don't want to be limited to using a crappy file format just because your TV can't handle anything else. Unfortunately, it's here that most ITVs stumble, and not just because no TV we've seen knows the difference between H.264 and MKV (see "Codec, or container?", right).

Few TV manufacturers list the codecs that their TVs support in their online specs lists, so you'll probably have to download the specific product manual and trawl through a 150-page PDF to find the information you want. However, we found that Philips lists the media compatibility of its televisions as standard on its website, which makes browser-window shopping much quicker.

Support matters

Codec support varies wildly between manufacturers and models. For example, Toshiba's 'Regza 40SL753' can only read 720P DivX 3, 4, 5, 6 video with 2-channel AC-3 from a USB stick, and only MPEG-2

files with LPCM, MPEG or AC-3 audio tracks from a DLNA server. Meanwhile, our Samsung 7000-series TV could handle AVI, MKV, ASF (including WMV ASF), MP4, 3GPP, VRO, VOB, PS and TS files with video codecs as disparate as DivX 3.11, Motion JPEG, WMV v9 and H.264. We wanted to check just how comprehensive this support is, so we threw our batch of Home Theatre PC test videos at it via one of its USB ports.

As we expected from its codec support list, the TV didn't recognise our MOV files – Apple's QuickTime container is a conspicuous absence. The Samsung fared well with the other test files, but it didn't know what to do with a 6-channel WMA audio stream, so some videos played with no sound – at least the television warned us that this would happen, so we weren't left thinking it was on mute or, worse, broken. The TV didn't support the MP4/S-MPEG 4 v2 video codec either. Samsung has done well to specify which video and audio codecs its TV supports, though, and the manual even states the maximum bit rate and frame rate that it can handle. The supported codec lists from other manufacturers tend to be just that – lists of file formats without clarification as to which combinations of codec and container are supported.

Some DLNA-compatible media servers can help to circumvent the problem of iffy file format support, as they're able to re-encode video on the fly and feed the TV with a video stream it can display. However, this typically requires either a high-end NAS box such as the Synology DiskStation DS210+, or a media serving program installed on a desktop PC such as TVersity (which we'll cover in a few pages) to transcode video. This isn't ideal: re-encoding anything leads to loss of quality, not to mention the extra time involved.

One aspect in which a media streaming TV performs well is user experience. So long as you buy the right TV, with the right codec support for your needs, the process of playing media is fairly stress-free. The TV has no moving parts, so there won't be any intrusive fan noise or vibrations during the movie and, as everything is integrated in one device, you'll only need one remote. Obviously user interfaces vary between televisions, but our experiences with the Samsung were very positive; browsing files was simple and clear; nonetheless, it didn't feel quite as well rounded and user-friendly as Windows Media Center or a dedicated media streamer.

Is ITV the way of the future?

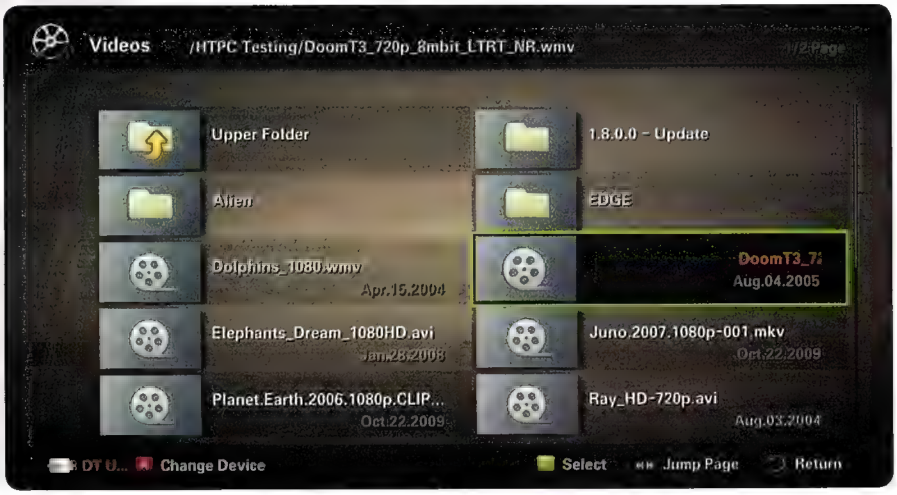
While many new TVs support media streaming, different models do so to a lesser or greater extent, and none has the comprehensive support that a PC or dedicated media streamer can provide. While some companies make a considerable effort, for others, digital media playback is an afterthought. Worse still, if your expensive new TV doesn't support the feature you want, there's nothing you can do about it.

The increasing level of tech built into TVs is very promising; the ability to stream web-based video, for example, is commendable. However, the variation between manufacturers and models makes a recommendation very difficult. If you're after a new TV, look for the mainstays of picture quality – brightness and upscaling – and regard any streaming and media playback as a side-bonus rather than a must-have.

Codec, or container?

It's important to understand the difference between a codec and a container. A codec is a piece of software that can encode and decode a digital data stream, and the word itself is a compression of the function: COder-DECoder. There are two data streams in a movie file – audio and video – and these are combined into a container file, usually known as a container. For a device to be able to play a movie correctly, it has to support the video codec, the audio codec and the container.

You can use applications such as GSpot (**www.headbands.com/gspot**) or Media Info (**http://mediainfo.sourceforge.net/en**) to find out which codecs and containers your current movies use. Common containers include WMV, MKV, MOV, MP4, ASF and AVI. The Internet has adopted MKV as its de facto high-definition standard container, as it tends to have better support for alternative subtitles and audio tracks – English, Swedish, French and so on – so that's an important file type to support. We like the H.264 video codec – while it takes a fair amount of CPU power to encode using it, it provides a high-quality video stream and a smaller file size than competing codecs. MPEG-4 and WMV v9 are also popular video codecs. The main audio codecs are MP3, AC3, AAC and WMA, but we'd advise avoiding MP3 where possible, as the latter three have plenty of support and produce a better result, while having support for true multi-channel audio.



+ Easy to use
Reliable

- Expensive
Limited format support

Total Price

From $1250

Game consoles

Today's gaming consoles often tout their media playback abilities, but are the Xbox 360 and PlayStation 3 as good as they claim?

Whereas a dedicated Home Theatre PC, media streamer or Internet-enabled TV will probably cost you a fair amount to set up, if you have a PC and either a PlayStation 3 (hereafter referred to as the PS3 for brevity) or an Xbox 360 (hereafter referred to as the 360), you have everything you need to play your digital media collection on your TV. It isn't always the most straightforward task, though, and requires some work to set up.

The most significant difference between playing your media on a console and using a Home Theatre PC or media streamer is that both the 360 and PS3 require a media server, such as a NAS box or PC, running on another machine on your network in order to stream video. You can't simply create a shared folder on your PC and access it from your console. Similarly, while you can connect USB storage devices such as hard drives or flash sticks, both consoles can only read FAT32 formatted volumes, which only supports files up to 4GB – not enough for some HD content

A media server is a software application that runs on either a PC or NAS box that catalogues and serves media to compatible devices over the network. You tell the server which files and folders you want it to share, and it will broadcast its presence over your LAN. Any compatible media device on the same network, including other PCs, consoles and media streamers, can then select that server and play the available contents as if it were on the device's local hard disk. The difference between this and simply accessing a shared folder is that media servers will typically index files based on file type, name or other file data, which is easier to use than just manually browsing for files.

Choosing a server

While setting up a media server sounds like a headache, it's usually remarkably simple; some NAS devices require no more than the ticking of a box. Windows Media Player (not Windows Media Center) is the most widely used media server and is as easy to set up as adding folders to your libraries, and then enabling the media server option in the media-streaming options. Windows Media Center, while sharing libraries with Windows Media Player, works very differently, extending its interface to compatible devices such as the 360 and integrating the slick WMC interface with the console's controller. WMC isn't compatible with the PS3.

There are also lots of independent media server options that offer extra features and often the ability to run on very low-powered, non-x86 platforms. Our experiences with these have been varied, but TVersity (see box, top right) is easily the best choice if you need more options than WMP offers. It still requires a full PC (albeit not a high-spec one) to run. Most modern media servers now support industry-wide standards such as UPnP (Universal Plug and Play) and DLNA, allowing a wide variety of devices to play media from a single media server.

While media servers ensure the media is stored away from your living room, the video files are still decoded and played locally on your console rather than the PC running WMC or a media server. As the console firmware is set in stone, you can't install a codec pack or similar, so you're stuck with whatever the console can play as standard. Thankfully, both the PS3 and 360 support a healthy number of popular formats, including MP4 and DivX encoded files. The 360 has a small advantage here, as it supports Apple's QuickTime format, which the PS3 doesn't. However, the major difference between the two consoles reveals itself when you try to play back HD content.

Codec support, and limitations

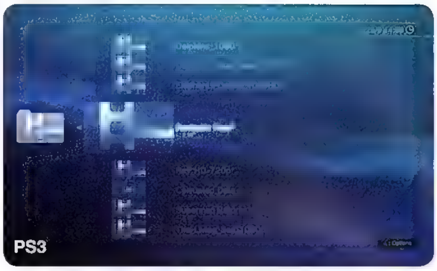
The 360 can play HD AVI and MPEG-4 Part 2 files, but only at a maximum resolution of 1280 x 720 – if the video is encoded at a higher resolution, it won't play. Many HD containers can contain H.264 codecs, including MPEG-4 and QuickTime, which the 360 can play. WMV files are also supported, at full a 1920 x 1080 resolution. In comparison, the PS3 can play all of its supported formats at their maximum resolutions of up to 1080P.

The main setback for both consoles is that neither supports the most popular format for HD movies available from the Web – MKV – and neither supports codec pack upgrades. Even the on-the-fly re-encoding in TVersity can't understand this container, so you'll need to re-encode these files manually to play them on a 360 or PS3.

For the PlayStation 3, there's piece of free software, MKV2VOB (**http://goo.gl/AmlJ2**) that extracts the MKV and puts it into a compatible file wrapper; the actual audio and video codecs contained in the MKV are probably supported by the console, just not the MKV wrapper itself.

For the Xbox 360, the process takes much longer, as you'll need to re-encode the files using software such as Any Video Converter (**http://goo.gl/Vkya5**) to output the file as a WMV. This process can take many hours, even on a PC with a fast multi-core CPU.

As well as standard file playback, streaming media from online sources is also important, and this is where the largest divide between the 360 and PS3 appears. Thanks to its integrated web browser, the PS3 is easily able to access video from sources such as



YouTube or Vimeo, playing as normal through the browser, although high-definition streams aren't supported. In comparison, the 360 only offers video streaming via pay-to-play services such as Foxtel which, while possessing a superior range of premium content, isn't what most people want.

When it comes to the experience of watching video, each console's unique hardware and software makes a big difference. The PS3 interface is minimalist, so browsing through media folders is smooth, simple and uncluttered. In contrast, while the 360 can act as a Windows Media Center extender, granting it the swish WMC interface, the rest of the UI is very cluttered, and browsing through a media server library is made frustrating by the interface displaying comparatively few items on screen at once.

One of the most important features of any home cinema setup is the noise it generates from its moving parts. The original 360 was a notoriously noisy beast when playing games, and while this improved during video playback, it was still annoyingly intrusive. Later models of the 360 have much better cooling and so make a lot less noise, although it's still audible. The PS3 is much quieter during video playback and only really audible when you sit within a foot of it.

Are consoles for me?

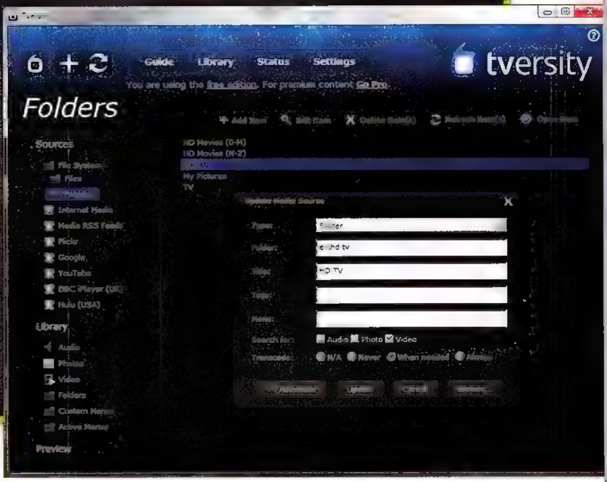
Using a console for media streaming is certainly viable, but a number of elements let this choice down. Running a media server on your power-hungry PC is far from ideal, but it's necessary due to the varying degree of standard codec support on both consoles. This is exacerbated by the lack of support for MKV files, the most common online high-definition video file. While media-streaming support is at least passable on the PS3 (although it lacks HD Flash video support), the 360 is dreadful at video streaming outside its list of approved partners. On the plus side, if you already have either console, setting up media streaming will cost you nothing. However, if you're thinking of buying a console exclusively for media playback, you might want to think again. There are better, cheaper and more flexible options out there.

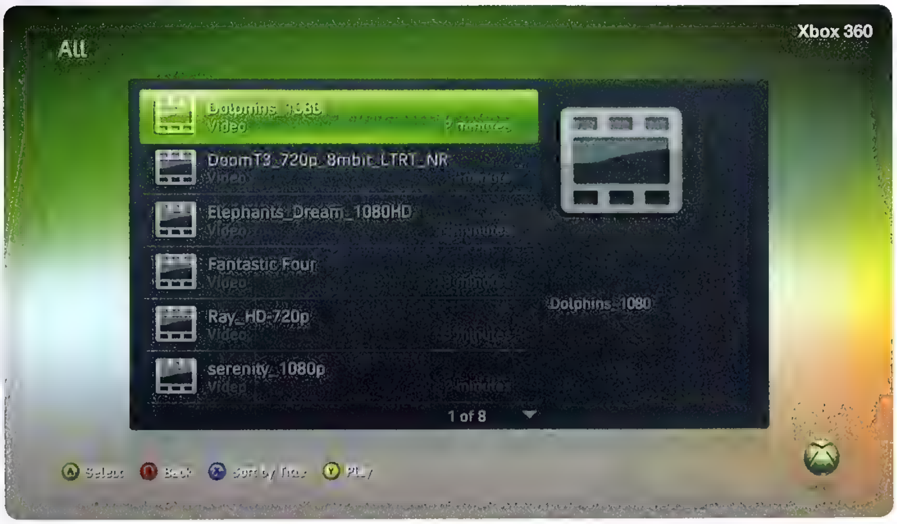
TVersity for your telly

TVersity is our media server of choice when it comes to streaming video to consoles from your PC, and its most attractive feature is transcoding. Depending on which device is connected to the server, TVersity will re-encode media files on the fly into a format supported by that device, which would otherwise be unable to play it. All this is carried out on your PC, and it even includes a decent set of pre-installed codecs to do the job.

TVersity is also one of the easiest media servers to set up. As well as the codec pack, the setup process offers to configure your firewall correctly. Once installed, the server will start up and launch the user interface. From here, you can configure the transcoding settings, set your network speed (wired 100/1000Mbps, wireless a/b/g/n) and tweak the streaming settings. You should leave all the settings at their defaults to begin with, though, as they should work fine with both the PS3 and the 360.

From the Library tab you can easily add folders from your local and network hard disks that you want to be shared. If you add a file to one of these folders and want to watch it immediately, however, you'll need to force a manual re-sync by selecting one or more library location[s] and clicking the Refresh Items button. This isn't ideal, but the scan is usually completed very quickly. Another downside of TVersity and most other PC media servers is that they can't run on a NAS device, forcing you to leave your PC turned on the entire time that you're watching media via your console.





+ Cheap
Verstatile

– Needs a server
Can be noisy
Re-encoding files is a pain

Total Price

250GB Xbox 360
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160GB PlayStation 3
From $469 (Plus Your PC)

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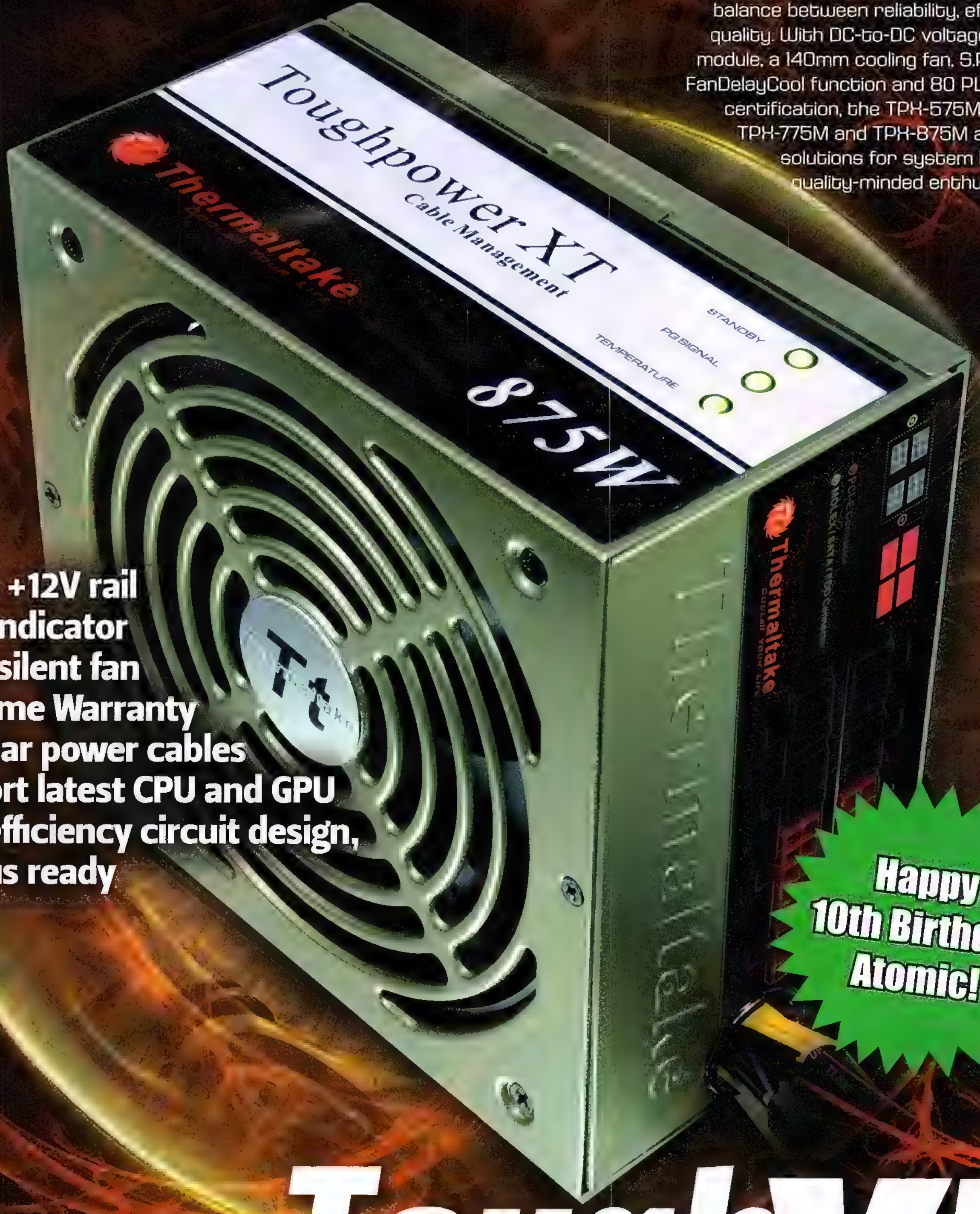

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Home Theatre PC

Home Theatre PCs are the tried and tested way to play downloaded video on a TV, and offer all the flexibility you'd expect from a full PC. But are they all they're cracked up to be?

Ask any PC builder worth their salt what the best way is to play a digital media collection in a home cinema setup, and we imagine that the answer would be a Home Theatre PC. A dedicated Home Theatre PC is, in theory, the best way to watch TV, as it allows you to upgrade or cut back on hardware, depending on what you want to do with it. Also, as long as the specs are even half reasonable, you can access any online streaming service and play any digital file you can find.

Of course, putting together a Home Theatre PC is much more complicated than buying a piece of hardware, such as a media streamer off the shelf, or using the features integrated into your TV. A Home Theatre PC has the same basic requirements as any PC – CPU, memory, motherboard, PSU and so on – but the priorities are very different, as our HTPC build in Kitlog highlights.

As impressive as full 1080P video looks, even an aging dual-core processor such as an Intel Core 2 Duo E6400 can handle playback, so you don't need the huge amounts of processing power of which modern CPUs are capable. Even Flash high-definition streams, which consoles struggle to play, pose little problem for a three-year-old dual-core desktop processor. Old single-core chips or very low-end hardware such as Intel's Atom range of processors aren't an option, though, as they're both too old and slow, or are designed for very low-power environments and are not up to the task of playing 1080p video smoothly. For our demonstration build, using all new parts, we've opted for a dual-core 32nm Intel Pentium G6950 CPU running at 2.8GHz, which is slightly overkill for just playing and streaming video.

Keep an eye out for low-noise hard disks.

HTPC theory 101

Using less powerful gear will save you money and reduce your Home Theatre PC's power consumption and heat output, two critical aspects of running a Home Theatre PC continuously. More heat requires more cooling, which inevitably means more fan noise – which you really don't want during those tense, quiet sequences in movies. By using a low-power chip and not overclocking it, we can also use Intel's low-profile reference LGA1156 CPU cooler, which is capable of very quiet operation.

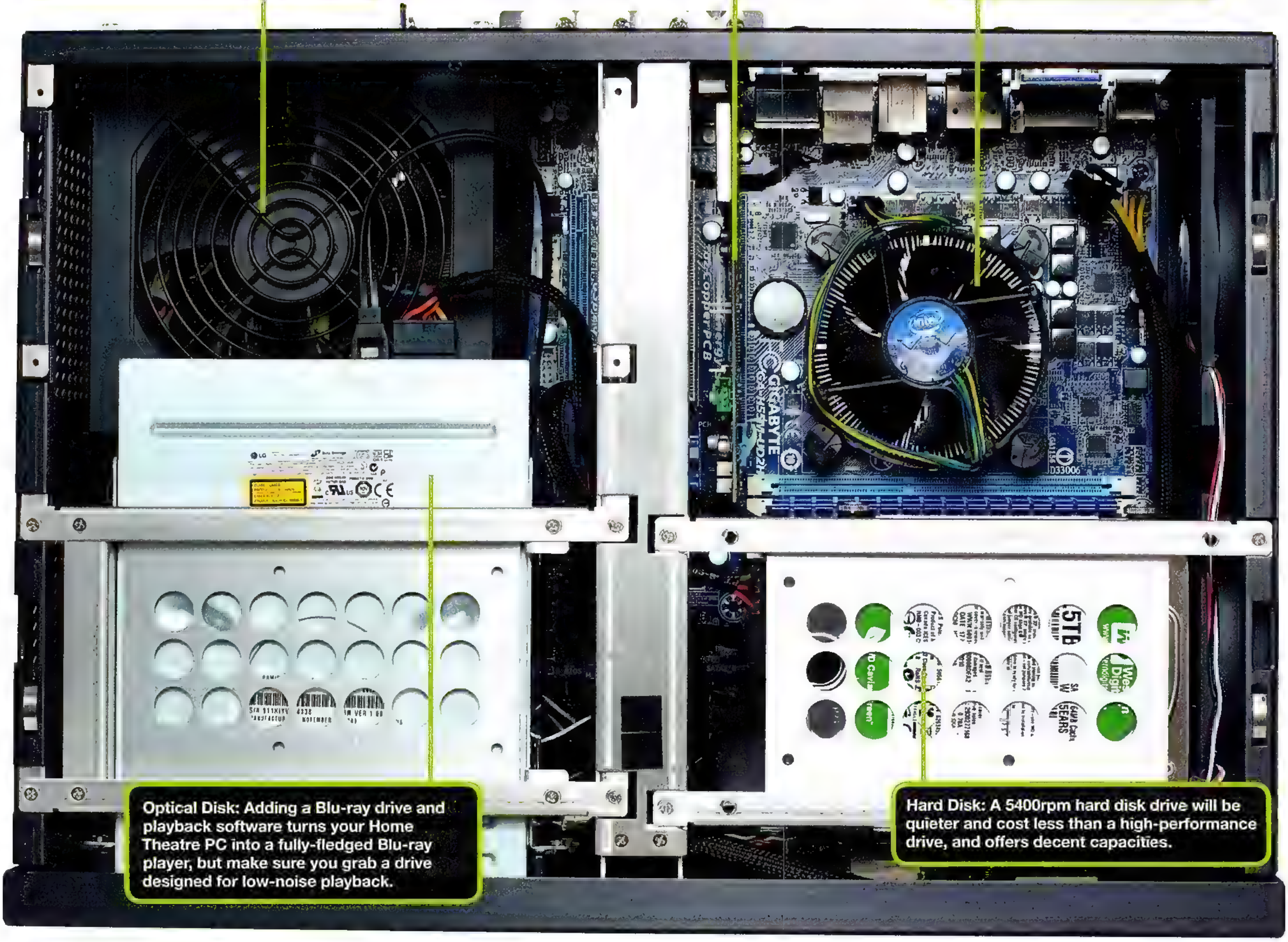
Low-noise components for a Home Theatre PC need to extend beyond the CPU cooler and case fans too. Hard disk noise is a frequent offender, so it's worth looking out for a case that includes rubber grommet vibration-absorbing mounts. Cheap 5400rpm hard disks such as Samsung's SpinPoint F3 1.5TB are a great way of reducing drive noise and saving money. You should also be careful with optical drives, especially if you plan to use your Home Theatre PC to play DVDs or Blu-rays. Desktop optical drives are rarely optimised for silence, so look for a specific low-noise model. We used an LG CH08LS10 BD-ROM drive that reduces the read speed during media playback to prevent noise.

As with the CPU, you don't need a powerful GPU in a Home Theatre PC. Thanks to Intel's integration of on-board graphics onto some of its CPUs (such as the G6950 we've selected), a discrete graphics card isn't necessary unless you want to play games on your Home Theatre PC. In our system, the CPU does all the work during playback, and while DXVA (DirectX Video Acceleration), which offloads video playback to the GPU, has been integrated into Windows 7 and a number of media players, our experience of it has been patchy. Playing media on the GPU is more power-efficient in theory, but file format support isn't great and doesn't include high-definition mainstays such as MKV files as standard. While these can be added via third-party vendors, it's an inelegant solution that often requires tiresome software updates. Adding a graphics card to a Home Theatre PC also means that unless you use a passively cooled card, you're adding another fan, further increasing noise. As such, unless you're reusing old hardware, we'd advise not installing a discrete graphics card in a Home Theatre PC.

Picking your software

While there are numerous players for playing Home Theatre PCs, the one easiest to use in the living room is Windows Media Center (WMC). Integrated into Windows 7 Home Premium and Ultimate, WMC is an extension of Windows Media Player and adds a slick, remote-friendly interface for video playback and library navigation. It's basically capable, allowing for easy browsing of music and video collections by sharing Windows 7's simple library system. Codec support has improved dramatically over previous versions, and WMC in Windows 7 can handle popular file types such as AVI, and codecs such as DivX or XviD. Sadly, the high-definition format MKV isn't supported, so you'll need to install a codec pack to support it. Codec packs are a thorny issue among Home Theatre PC users, as many are overloaded with useless codecs, as well as occasionally laced with spyware. We've found DivX's DivX Plus Codec Pack (**http://goo.gl/7g7JW**) to be the most reliable and reputable choice for adding MKV support to WMC in Windows 7.

Even with improved codec support, though, WMC isn't the simplest or most intuitive software when it comes to more in-depth settings or features such as subtitle support. We've had great success with the open-source Xbox Media Center (**http://goo.gl/M5Clo**), a more fully-featured overlay program, though it requires a little more effort to configure. Neither is it always ideal to have an overlay-style media player, especially when



Power Supply: A Home Theatre PC shouldn't require a high-wattage power supply; if you fit a discrete graphics card, a 300W model will be more than sufficient.

TV Card: Fitting a TV card to your Home Theatre PC allows you to watch and record digital TV from your computer.

CPU Cooler: Intel's stock cooler might not handle overclocking particularly well, but it's fine for a Home Theatre PC.

Optical Disk: Adding a Blu-ray drive and playback software turns your Home Theatre PC into a fully-fledged Blu-ray player, but make sure you grab a drive designed for low-noise playback.

Hard Disk: A 5400rpm hard disk drive will be quieter and cost less than a high-performance drive, and offers decent capacities.

you want to view Internet content. You'll also invariably need to maintain the PC in other ways, such as downloading and moving files around or applying updates, for which you'll need to exit WMC. With this in mind, a simpler media player such as VideoLAN's VLC is preferable (**http://goo.gl/jalzP**), as it offers straightforward, no-frills playback and comes with all the codecs you'll need baked in.

Another trump card for Windows Media Center is its digital TV tuner support. By adding a WMC-certified TV tuner, your PC can not only receive standard free-to-air signals but also act as a DVR, recording programmes as a TiVo does. However, download and streaming services are preferable, as there's no need to set up a file to record and you don't risk finding that your recording is missing the first or last five minutes of a show.

The main advantage of a Home Theatre PC, though, is its unmatched support for online video streaming. Flash-based movies, especially demanding high-definition streams, are too much for the simpler processors in game consoles or media streamers, but an x86 desktop PC processor has no such problems. Accessing video is as easy as visiting the service of your choice and pressing play, although this requires the use of a mouse and keyboard rather than a WMC-compatible remote.

Should I build a HTPC?

For all its flexibility, a Home Theatre PC isn't the easiest way to play digital media on your TV. Though none of the alternatives can match the level of codec support, ability to play physical media or ease of access to online streaming, even relatively affordable Home Theatre PCs cost over $750, which is much more than any other alternative, and the experience isn't perfect. WMC works well when matched with a WMC remote, but feels clunky with a mouse and keyboard. Plus, constantly jumping from WMC to a regular desktop to move files, update software or access online video streaming services is tiresome when all you want to do is sit down and enjoy a movie. Though a HTPC can be very quiet during media playback, it requires relatively constant attention. In the end, a Home Theatre PC looks fantastic on paper, offering a great deal of functionality, but usually results in an overly complex experience. Ultimately, there are cheaper, simpler and less intrusive ways to transfer your downloads onto your TV.

+ Plays everything
Customisable

- Expensive
Needs frequent maintenance
Can be noisy

Total Price

From $750

Tom Clancy's Rainbow Six Raven Shield — 2002
Tom Clancy's Ghost Recon — 2003
Beyond Good & Evil — 2004
Far Cry — 2005
Heroes V of Might and Magic — 2006
Assassin's Creed — 2007
Far Cry 2 — 2008
Tom Clancy's EndWar — 2009
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Tom Clancy's Ghost Recon Future Soldier — 2011

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Media Streamers

Specialist media streamers are small, silent, and cheap, and can match more elaborate hardware for playing video. Does a lack of streaming support let them down?

While the specifications of a typical Home Theatre PC and the current crop of consoles have remained unchanged for a number of years, developments in special-function low-power processors have allowed a whole array of video playing devices to emerge that are capable of playing even the highest bit-rate video. While first-generation devices were more focused on integrated TV tuners and standard-definition video playback, the latest array of media streamers have won us over with their integrated network ports, greatly improved codec support, and more intuitive interfaces.

Considering that a single-core dektop CPU will have trouble playing high bit-rate HD video, you might be wondering how such a small, low-powered box can manage the same feat. The answer is that the processor or chipset inside modern media streamers is extremely specialised, and has been expressly designed for playing video and music.

With the rising popularity of media streamers, competition between processors is fierce; Realtek and Sigma chips dominate the market. This means that streamers can differ widely not only in terms of performance, but also in software and user interfaces. Of the many media streamers we've looked at, the WDTV Live ($175), the AC-Ryan PlayOn! HD Mini ($150) and the ASUS O!Play Air HDP-R3 ($185) are the ones most worth considering.

Are they hardware, software, or both?

Both the AC-Ryan and ASUS streamers use the same Realtek 1073DD 400MHz processor, while the WDTV uses a Sigma 8655 500MHz processor. All three can handle a huge variety of file formats, and you'll have to try hard to find a file that won't play on them using each player's latest firmware. MKV files are fully supported, as are ISO disc images; although strangely, neither streamer processor supports Blu-ray menus when read from an ISO file. All three media streamers support all the popular codecs: DivX, XviD, MPEG-1/2/4 and H.264. ASUS and AC-Ryan support DTS, Dolby Digital and Dolby TrueHD 5.1 audio, and can down-mix to 2-channel speakers. The WD supports passthrough to dedicated audio equipment for all these 5.1 audio formats over HDMI, but cannot down-mix.

+ Cheap

Wide range of supported codecs

Silent

Easy to use

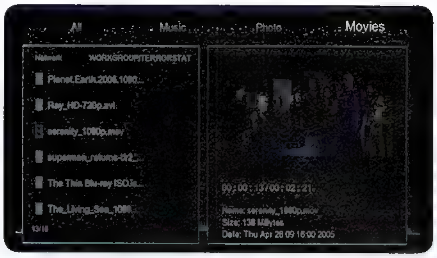
− Limited support for internet streaming

NAS storage is an added cost

All three media streamers receive regular firmware updates that add new codecs. With such a high level of codec support, the chipset becomes the limiting factor, and even then only with ultra-high bit-rate files. In this respect, the WD has the edge, as we've yet to find a file that hasn't played flawlessly; while the AC-Ryan and ASUS stuttered when playing ultra-high bit-rate files over 32Mb/sec. It's rare to have such high bitrates, though some consumer micro 4/3 cameras support video recording using AVCHD at these settings.

User interfaces can also differ dramatically between various media streamers. As they run on the same CPU, the AC-Ryan and ASUS media streamers have similar interfaces and, to be frank, they're not the most intuitive. This is particularly obvious when you look at their remote controls, both of which are overly complicated and button-heavy. The WD's remote is much better, however, with smooth navigation and transition between windows. It isn't as swish as the PlayStation 3 XrossMediaBar interface, nor as user-friendly as Windows Media Center, but it's very simple to navigate and use, and has a similarly idiot-proof remote.

The low-power processors at the heart of



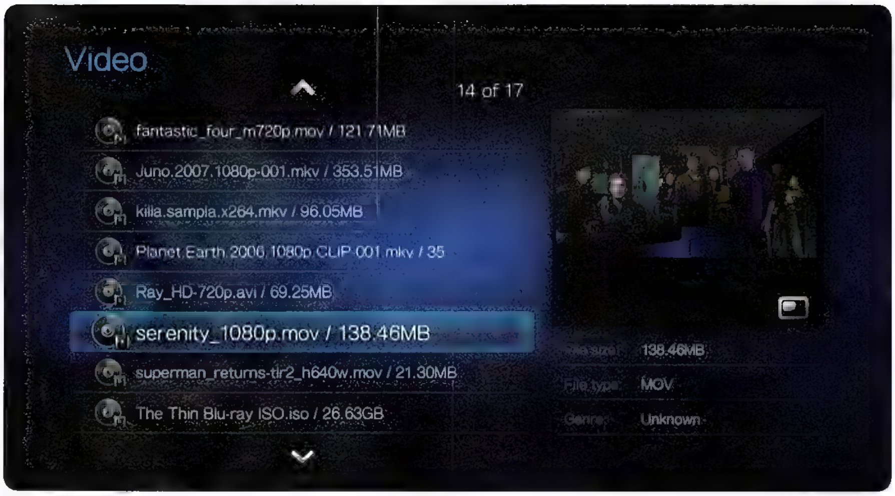
the media streamers also have the benefit of producing comparatively little heat, which enables all three devices to ship without any form of active cooling. As they're quiet, they won't get in the way your enjoyment of your media. You'll need to be careful where you place a media streamer, though, as a passively-cooled unit will require a decent amount of room around it to breathe. Also, it isn't advisable to place a media streamer on top of any other piece of AV equipment such as a set-top box, as these become warm during use and may cause your media streamer to overheat.

Getting started

Setting up a media streamer as a standalone unit is supremely simple. All you need to do is connect the player via HDMI to your HDTV and power it up. All three units we've featured include optical S/PDIF outputs for connection to dedicated audio equipment and USB ports for connection to USB storage devices, with support for FAT32 and NTFS file systems.

The inclusion of 10/100 network ports and wireless support – which is included as standard in the ASUS, and an option for the WD ($30, supported devices at **http://goo.gl/kmVS9**) and AC-Ryan ($37, official adapter) is crucial – unlike consoles, media streamers can play files directly from a shared network folder. This means that making a file accessible to your media streamer is as simple as dragging it to a shared folder on your PC and browsing to it on the streamer.

While this means that a media streamer is reliant on external storage for your media collection, unlike a Home Theatre PC, the fact that it can browse directly to shared folders makes it the ideal partner for a NAS box. These incredibly useful devices can be connected anywhere on your network, preferably far away from your living room to eliminate the small amount of noise they produce, and make the contents of the hard disks available over the network as if they were connected locally. There's a great variety of products in the NAS market, as we found out during our recent Head2Head testing (see Issue 117, page 59), but the Synology DiskStation DS210J+ is a great choice. It's easy to set up and reasonably affordable at just under $640 without hard disks. It's also a great performer with a host of extra features besides shared folder hosting; a BitTorrent client, download manager and one-click media server setup are just the tip of the iceberg.


Video
14 of 17
fantastic_four_m720p.mov / 121.71MB
Juno.2007.1080p-001.mkv / 353.51MB
killa.sampla.x264.mkv / 96.05MB
Planet.Earth.2006.1080p.CLIP.001.mkv / 35
Ray_HD-720p.avi / 69.25MB
serenity_1080p.mov / 138.46MB
superman_returns-tlr2_h640w.mov / 21.30MB
The Thin Blu-ray ISO.iso / 26.63GB
File size: 138.46MB
File type: MOV
Genre: Unknown

As with a Home Theatre PC, it's not necessary to pack a NAS with high-performance hard disks – even the fastest NAS boxes for sale today have a maximum read speed of 38MB/sec, which is much less than even a 5400rpm hard disk's read speed. As an added bonus, slower hard disks are typically cheaper, run cooler and are quieter than high-performance drives. For our NAS box, we've opted for a 1TB Western Digital Caviar Green disk, costing just $75, with the option to add a second drive for data redundancy at a later date. However, 1TB is still a huge amount of data, enough for between 100 and 200 DVDs. Of course, any shared folder on any PC in your network will work just as well with a media streamer, but by offloading the job to a NAS, you don't need to worry about switching on a PC just to watch a film in another part of your house. There's also the added benefit that any other PC in your house is also able to access the NAS simultaneously.

How do they handle the internet?

While media streamers rule when it comes to playing non-DRM protected media, video streaming from popular online sources is regrettably lacking. All three media streamers we've looked at support YouTube in standard definition but not YouTube HD, and support for alternative video services has been long-rumoured, but is disappointingly absent. Frustratingly, while the devices are certainly up to the task of streaming Flash video, there's a limited access to actual content; the WDTV has been upgraded in the USA to support the video-streaming service NetFlix. Sadly, Aussie users of all three players miss out on support for streaming such as ABC's iView. This means that you'll have to turn to subscription-based TV services such as Foxtel for streaming via a set-top-box, or simply use free-to-air.

Despite the lack of streaming services, a media streamer's greatest advantage is its incredibly competitive price. Streamers cost as little as $150, which is one fifth of the cost of a dedicated Home Theatre PC, or a third of the cost of a PS3 or an Xbox 360. Even when you factor in a top-quality NAS box such as the Synology DS210J and a 1TB drive, the total cost is still comparable to a HTPC for a silent and incredibly capable media setup.

The streamer wins

A high-quality media streamer such as the WDTV Live paired with a NAS box in another room is easily the best way to enjoy downloaded or backed-up media on your TV. The wide range of supported codecs and ease of configuration make it easier to use than a a maintenance-heavy Home Theatre PC, and with the added flexibility offered by pairing with a NAS box, you don't require a media server on a PC to host your files. The only downside is the poor access to popular online streaming services outside of YouTube, which means that you'll need to look elsewhere for your internet video fix. Even without the addition of streaming services, though, a media streamer and NAS box are our hardware of choice for playing digital media on a TV.

Now where did we leave that remote...

Total Price

WDTV Live
$175

AC Ryan PlayOn! HD Mini
$150

ASUS O!Play Air HDP-R3
$185

Cooler Master adds another new member to the HAF series, the HAF 912 Advanced. To carry the mission of providing the best thermal solutions, HAF 912 Advanced supports two 120 mm for external radiator and high-end CPU coolers. Furthermore, the spacious interior accommodates two 200mm fans and two-120mm fans for better and superior airflow yet, enough to fit 12 devices and high-end GPUs such as Radeon HD5970 and Nvidia GTX 480. HAF 912 Advanced features rugged looks, massive air cooling and trademark interior that signifies performance and makes it a killer machine.

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	MSY Technology	07 3217 9070	www.msy.com.au
	Umart Online	07 3369 3928	www.umart.com.au
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	Netplus Micro Computers	08 9242 7288	www.netplus.com.au

HARDWARE

NEWS, REVIEWS AND ROUNDUPS ON THE LATEST HARDWARE

Gaming peripherals. They're a very personal thing. Some of us like sturdy and solidy built and spendy, in the hope that they'll last years. And some of us like cheap and cheerful, so that when we die unceremoniously and unfairly in the middle of a mission we can. bash. them. into. the. wall. until. they. shatter. and not have to feel bad about it. Well, not too bad, anyway.

This month we round up and test the hell out of a bunch of the best gaming mice and keyboards, for every budget and level of rage-gaming.

There's also a whole mess of the kind of reviews you know you can expect from your local friendly Atomicans. And a bit of a look at something called Sandybridge...

You heard. Get reading!

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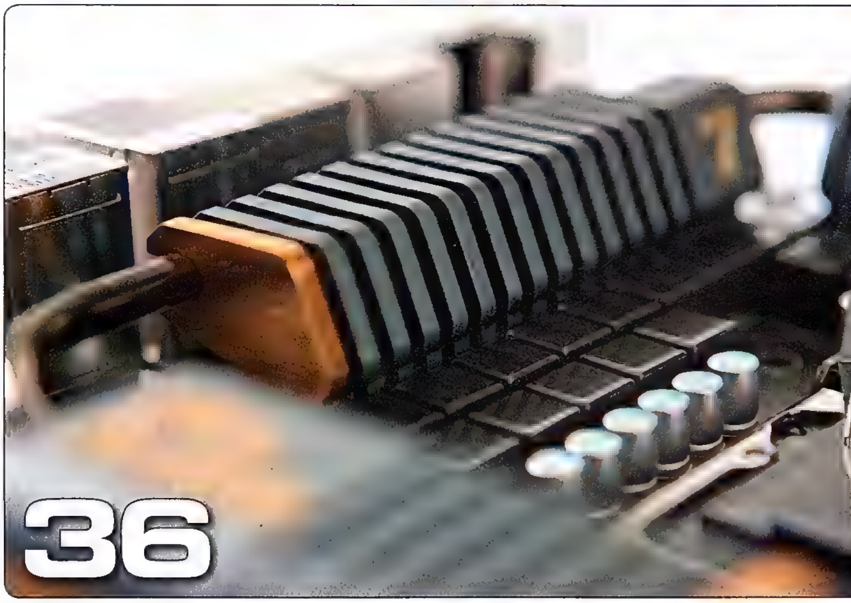
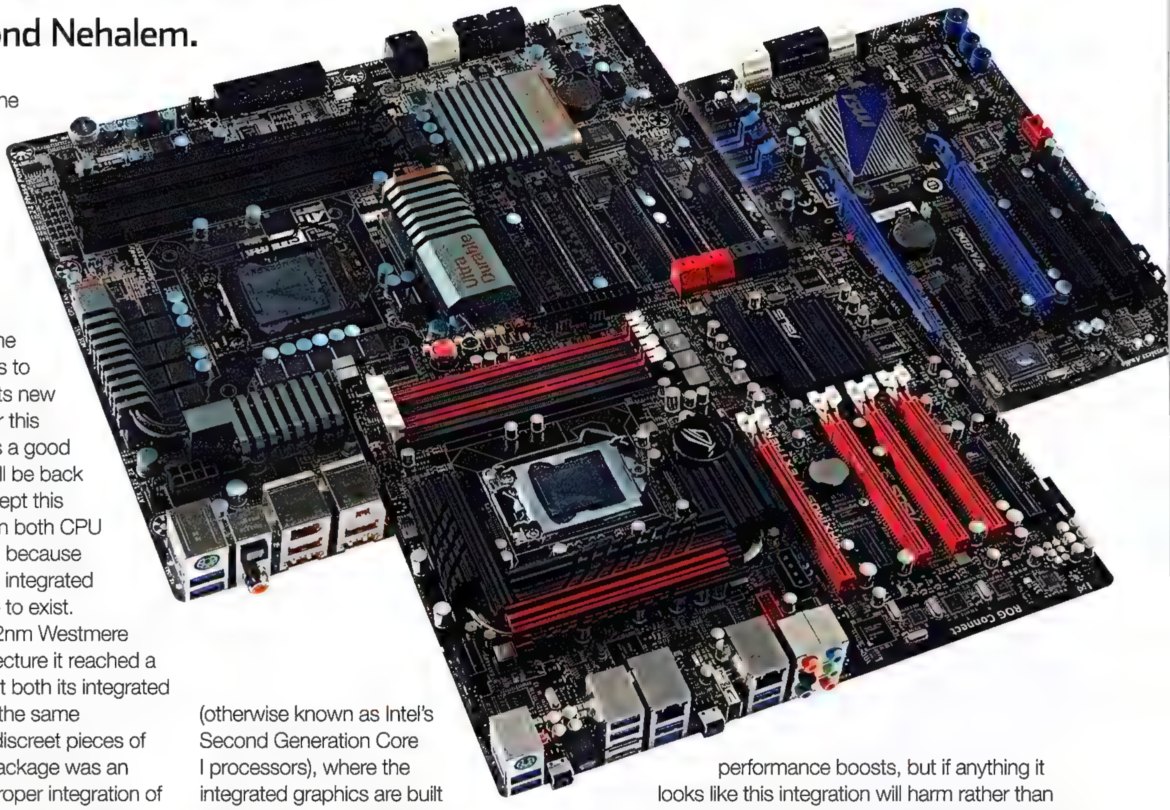


SANDY BRIDGE

Intel moves beyond Nehalem.



It's been a long time since the two CPU giants have clashed head on. Intel has owned the performance crown now for several years, and AMD just hasn't been able to keep its once great balance of price and performance going.

2011 is shaping up to be the best chance for the CPU wars to reignite – AMD won't launch its new desktop architecture until later this year, but when it does there is a good chance that Intel and AMD will be back to the competition of old. Except this time they will be competing on both CPU and GPU performance fronts, because 2011 is also the year in which integrated graphics as we know it cease to exist.

When Intel launched the 32nm Westmere refresh of the Nehalem architecture it reached a landmark moment when it put both its integrated graphics core and CPU onto the same packaging. While both used discreet pieces of silicon, this combination on package was an important step towards the proper integration of Intel's graphics and processor silicon designs.

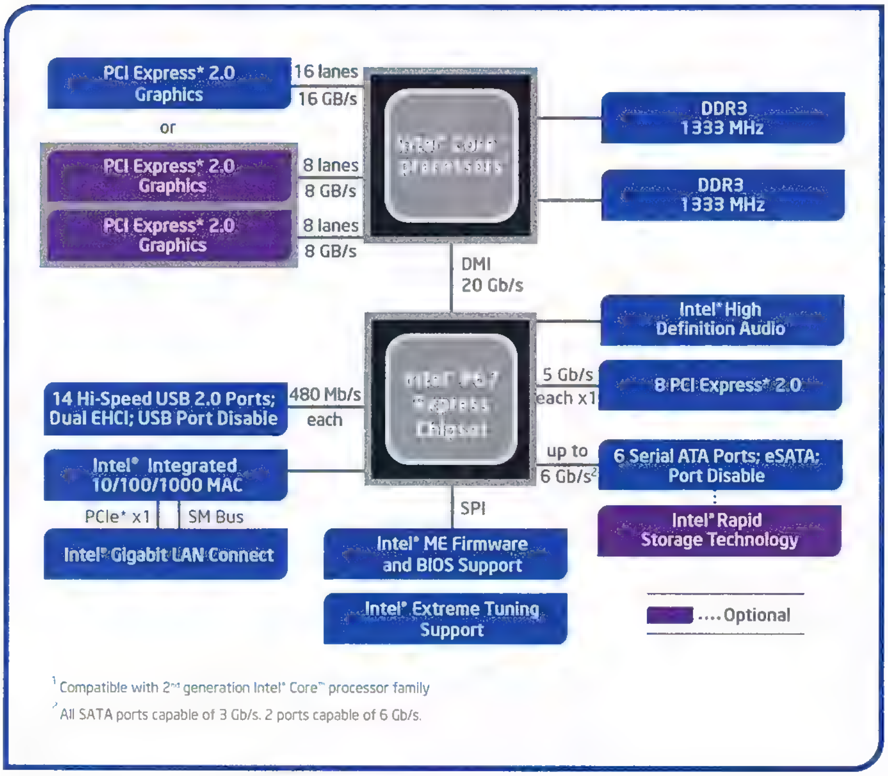
This integration occurs with Sandy Bridge (otherwise known as Intel's Second Generation Core I processors), where the integrated graphics are built into the CPU. This allows for better resource management, and big graphical performance boosts, but if anything it looks like this integration will harm rather than help enthusiasts thanks to the way it fits into the architecture.

Intel promises double the graphics performance over recent generations, and while double sounds impressive, it isn't when you consider that AMD and NVIDIA's discreet graphics are already orders of magnitude faster than Intel's.

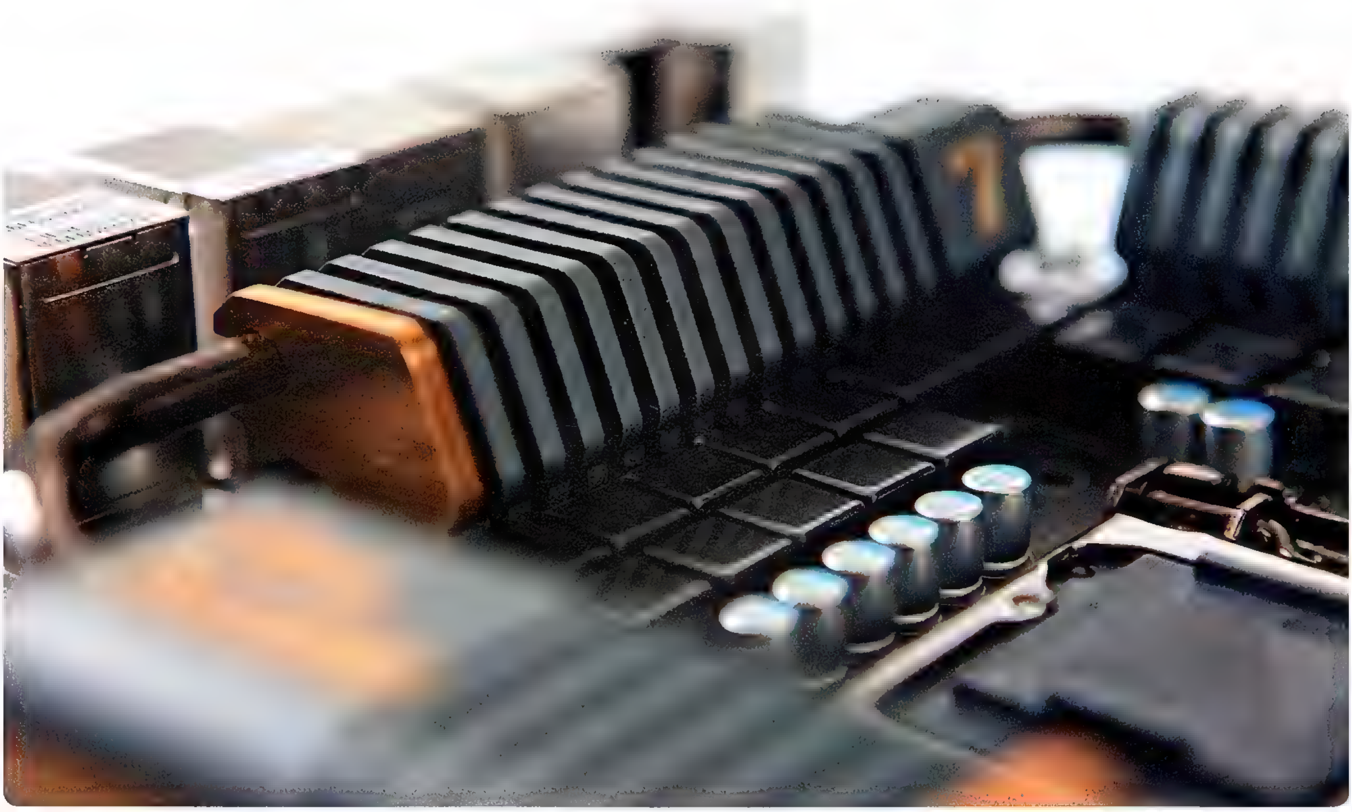
Like the first generation of Core I processors, the integrated graphics are only accessible if you use the right chipset. Initially this means Intel's H67 chipset not only enables the CPU to output images, but also enables a chunk of the media acceleration technology built into Sandy Bridge (although this is largely through CPU extensions – there is no DirectCompute/OpenCL support in Sandy Bridge).

As we all know, integrated graphics are very un-atomic. This has been borne out by the motherboards that we've been supplied to use for Sandy Bridge. Out of nine boards from various manufacturers the only H67 one we received came from Intel – the rest used the mainstream P67 chipset.

P67 is going to be the most common chipset encountered when building Sandy Bridge systems. For now at least Intel is keeping the 'Gulftown' Core i7 980x chip as its top performer and we know that there is at least one more Nehalem based Core i7-990x extreme edition to launch before this product line moves to the 32nm Ivy Bridge architecture late in 2011.


PCI Express* 2.0 Graphics
16 lanes
16 GB/s
or
PCI Express* 2.0 Graphics
8 lanes
8 GB/s
PCI Express* 2.0 Graphics
8 lanes
8 GB/s
Intel Core processors
DDR3 1333 MHz
DDR3 1333 MHz
DMI
20 Gb/s
Intel® High Definition Audio
14 Hi-Speed USB 2.0 Ports; Dual EHCI; USB Port Disable
480 Mb/s each
Intel P67 Express Chipset
5 Gb/s each x1
8 PCI Express* 2.0
up to 6 Gb/s²
6 Serial ATA Ports; eSATA; Port Disable
Intel® Integrated 10/100/1000 MAC
PCIe* x1
SM Bus
Intel® Gigabit LAN Connect
SPI
Intel® ME Firmware and BIOS Support
Intel® Rapid Storage Technology
Intel® Extreme Tuning Support
.... Optional
¹ Compatible with 2nd generation Intel® Core™ processor family
² All SATA ports capable of 3 Gb/s. 2 ports capable of 6 Gb/s.

Intel® P67 Express Chipset Platform Block Diagram



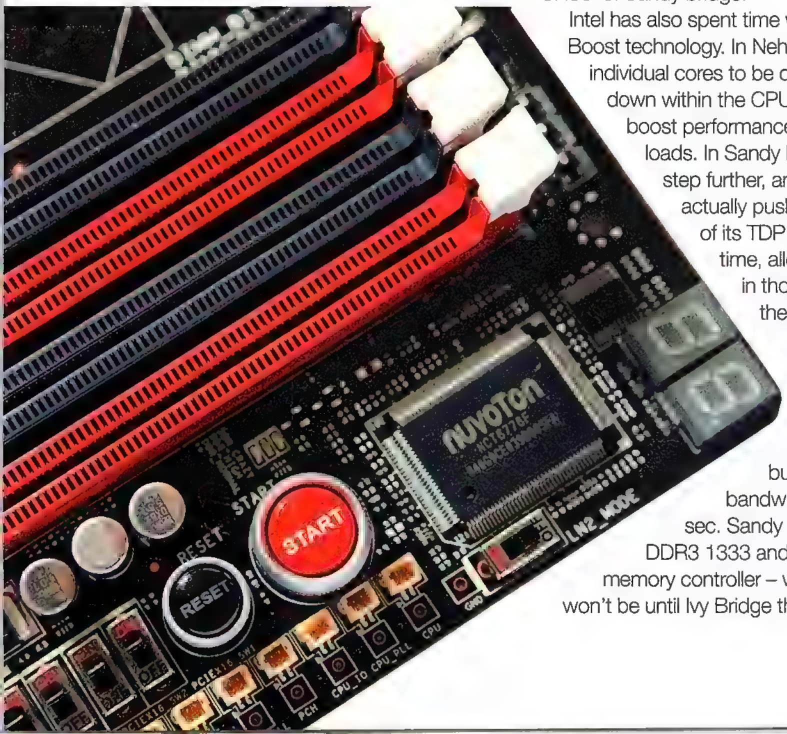
Under the heatspreader

Intel has described Sandy Bridge as having a ring architecture. This refers to the way in which cache is accessed in the CPU – both graphics and processor functions share L3 cache through this ring bus. The 256 bit bus also connects the cores within the CPU. This creates a situation where there is great interdependence between the graphics and CPU performance, and has meant that the QPI bus that was used in Nehalem is gone. In its place is a single 100MHz clock generator that provides the base clock for everything within the CPU. This is where the graphics may hinder enthusiasts – our preliminary testing and talks with overclockers indicate that this clock ends up providing a hard ceiling for just how far one can take bus speeds. The only real overclocking option is via the unlocked multiplier on the premium priced 'K SKUs' of Sandy bridge.

Intel has also spent time working on its Turbo Boost technology. In Nehalem this enabled individual cores to be clocked up and down within the CPU's TDP in order to boost performance in single threaded loads. In Sandy Bridge this goes a step further, and Turbo Boost can actually push the CPU outside of its TDP for brief periods of time, allowing for extra grunt in those moments when the CPU needs it.

The memory controller in the CPU has also been improved. It's still dual channel but has increased bandwidth of 25.6GB/sec. Sandy Bridge supports DDR3 1333 and 1600 with its inbuilt memory controller – we imagine that it won't be until Ivy Bridge that we see triple channel memory, and even then it seems that dual channel is the design most favored by Intel.

The other major addition to Sandy Bridge is the introduction of a new instruction set called Advanced Vector Extensions. These extend the SSE extension set and focus largely on floating point performance, allowing the CPU to crunch 256-bit numbers among other things. AMD has AVX support built into its upcoming Bulldozer core, and in many ways tweaking up the floating point units of the processor is a nod towards the rising importance of the floating-point focused GPU in general computing tasks.



The Chipset

With so much functionality now occupying CPU silicon, the P67 chipset is starting to look rather feature-poor. Look at the diagram and it's still quite similar to the P55 chipset. There are 16 PCI-Express lanes hooking into the CPU. These can function as a single x16 or dual x8 PCI-E lanes, facilitating dual graphics card setups (most motherboard manufacturers are slapping an NVIDIA nf200 chip on as well to enable three-way graphics).

The Southbridge chip runs the rest of the system interface. Intel hasn't added much to this processor, improving upon its optional Rapid Storage Technology by adding two SATA 6GB/sec channels, but leaving the rest as SATA 3GB/sec. Native USB ports are all still USB 2 as well, with mobo manufacturers left to rely on third party controller chips.

This reliance on third party chips is helped by an increase in bandwidth available to the eight PCI-Express lanes that hook into the Southbridge, with 500MB/sec of bandwidth available to each x1 lane.

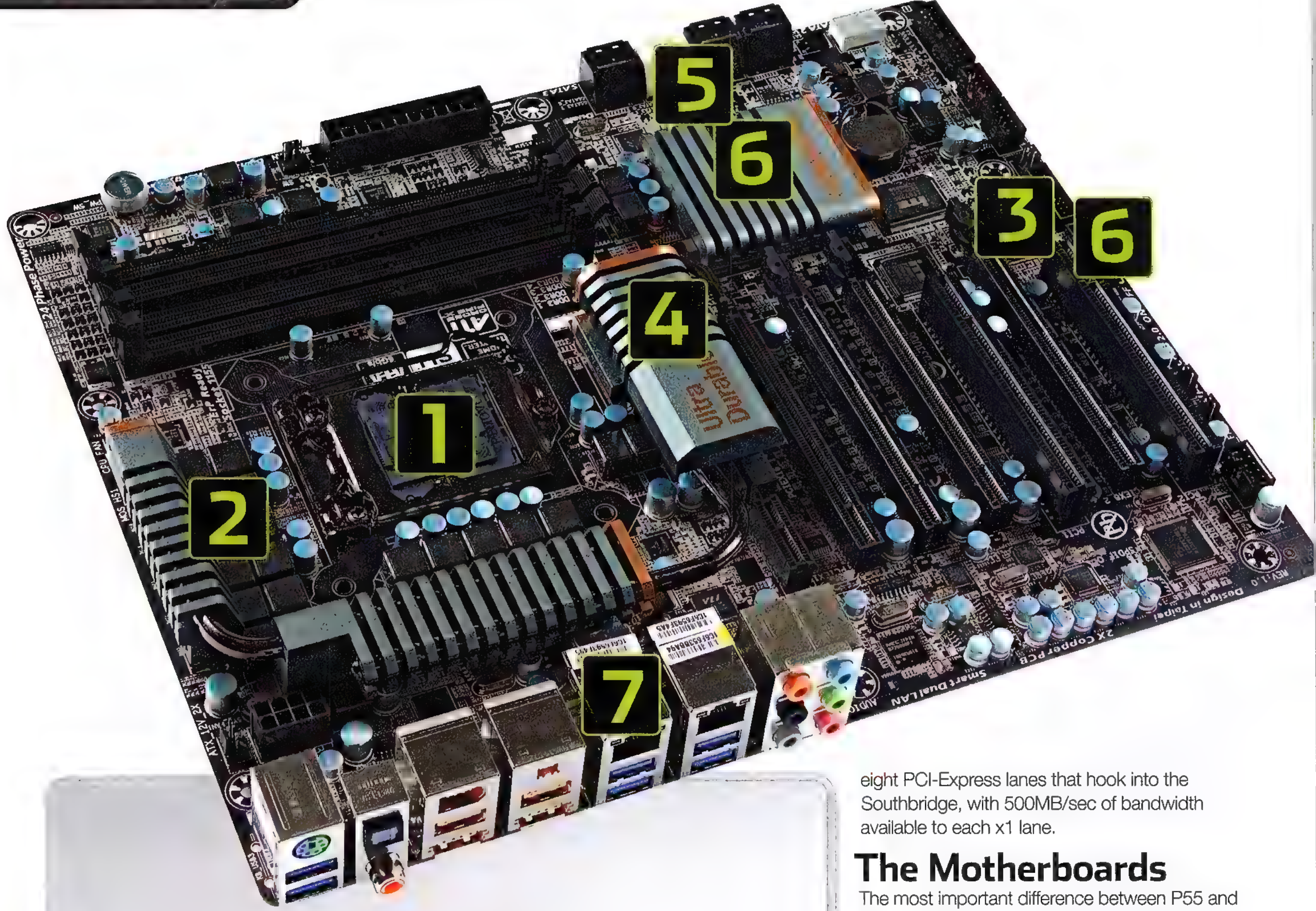
The Motherboards

The most important difference between P55 and P67 motherboards is the socket change. First Generation Core I processors use an LGA 1156 socket – Sandy Bridge uses an LGA 1155 one. This means that you will be physically unable to use the wrong processor in the wrong socket, and it means that you cannot reuse an old motherboard or CPU with the new hardware. LGA 1366 is still around, but it is purely used for Nehalem-based Core i7 processors, and Ivy Bridge will use a different chipset and socket when it launches.

As the chipset evolves more and more into a PCI-Express traffic controller, the onus is increasingly falling upon motherboard manufacturers to push technology like USB 3 and SATA 6GB/sec. Most of the Sandy Bridge motherboards that we have encountered are bristling with extra control chips, and this really puts pressure on manufacturers to perform.

The biggest non-Intel feature that appears on all the motherboards in our labs is USB 3. After a year in which both ASUS and GIGABYTE aggressively pushed this new technology we are definitely sold – forget the arguments about low numbers of USB 3 vs USB 2 products on the market, once you have used USB 3 it is incredibly difficult to settle for slower speeds.

Until now most motherboards have only had two USB 3 ports. This is because for most of 2010 the only certified USB 3 controller chip was NEC's 2-port one. High end Sandy Bridge boards are now packing several of these chips, complemented by 4-port Hub chips from VIA.



GIGABYTE P67A-UD7

1 The socket looks very similar to previous ones, but actually has one less pin than p55 boards do. This LGA 1155 socket is only compatible with Sandy Bridge.

2 GIGABYTE has taken the power circuitry from its monstrous X58A-UD9 overclocking board and used it on the P67A-UD7. This means 24 phases of power available to the CPU.

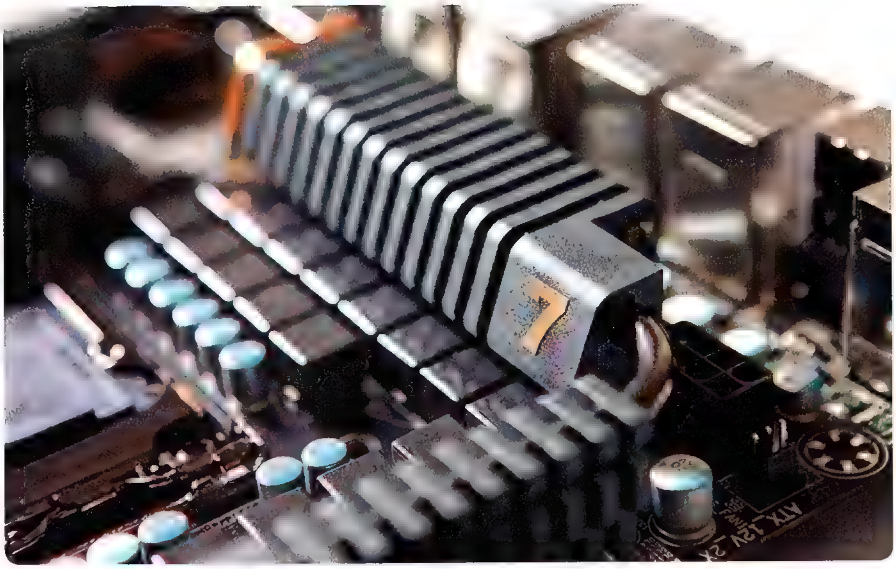
3 Because Intel has left USB 3 out of the chipset, manufacturers have had to use third party chips. This board uses a combination of NEC two-port controllers and VIA four-port hub chips.

4 Natively the P55 only supports a single x16 or dual x8 PCI-E graphics lanes. To further enhance graphics expandability a lot of manufacturers are using NVIDIA PCI-E chips in order to add a third graphics slot. We haven't seen any quad graphics implementations of P55 in the initial lineup.

5 The P67 only natively supports two channels of SATA 6GB/sec. This mobo also has a Marvell controller chip to deliver four channels of SATA 6GB/sec, though the other four SATA ports are only SATA 3GB/sec speed.

6 Finally we have a motherboard with USB 3 headers. Until now USB 3 ports on cases have needed clunky cables running out the rear of the case and plugging into the backplane. With some Sandy Bridge boards manufacturers have put enough USB 3 chips on to be able to dedicate some to motherboard headers.

7 This particular board bristles with expandability – there are more eSATA ports than you will ever need, which also double as USB 2 ports if you aren't using eSATA. This board also has dual Gigabit Ethernet and a single PS/2 port.



This paring allows for a massive explosion in the number of ports available, and the GIGABYTE P67A-UD7 for example, has 18 USB ports in total, 16 of which support USB 3.

NEC's chip is a known quantity and is being used by Asus, GIGABYTE, Intel and MSI to drive USB 3. ASRock on the other hand has gone with an uncertified chip from Etron. We asked Asrock about this somewhat odd choice and were informed that ASRock expected the Etron chip to pass the first round of official USB IF testing by the end of 2010, and that internal tests showed it was performing well.

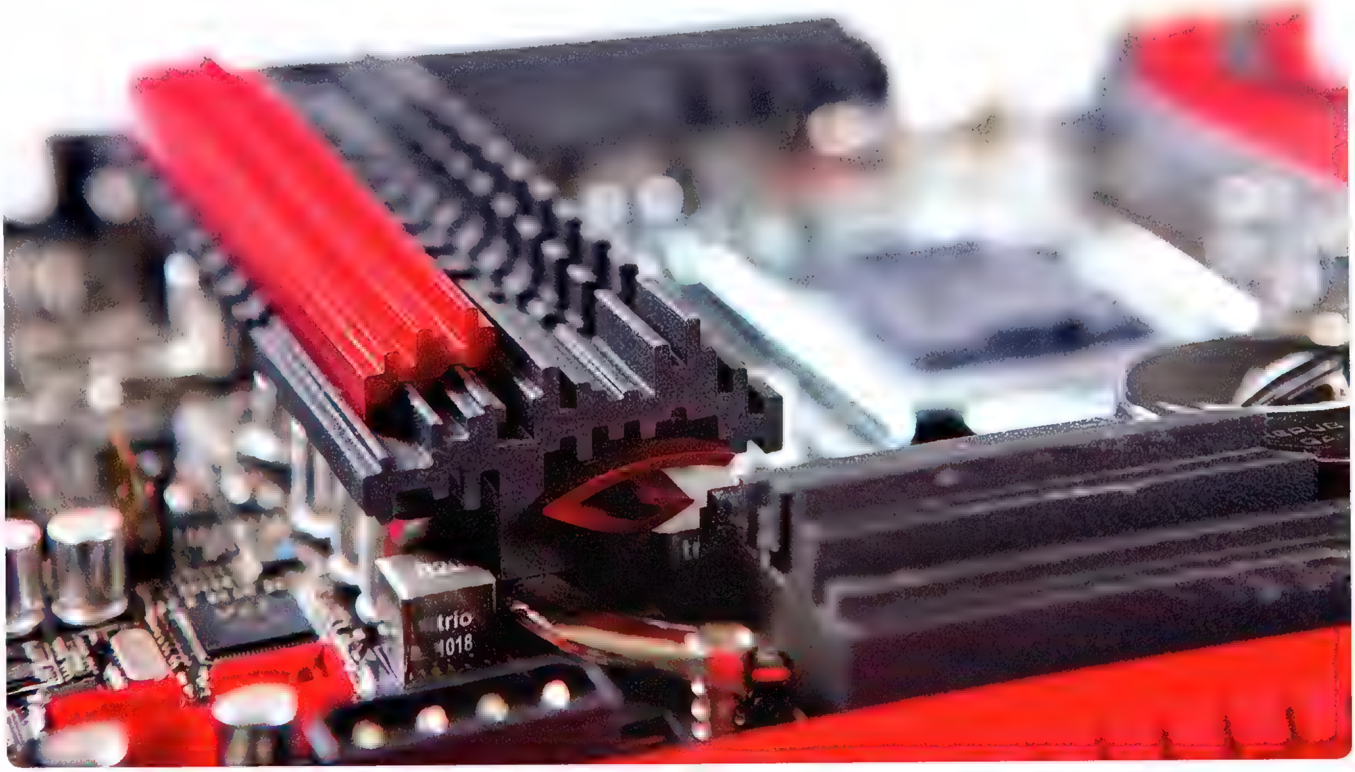
Besides the wholesale uptake of USB 3, the other major technology coming to the forefront with Sandy Bridge is the long awaited introduction of UEFI (we first wrote about this BIOS replacement in atomic six years ago). Manufacturers are implementing this in various ways, but what it does mean is that it brings support for booting from GPT partitions and other tech needed to boot from hard drives greater than 2.2TB in size.

Of course, we still think that a boot SSD with large capacity storage drives is the best idea, and to this end Intel's Rapid Storage technology is designed to deliver great SSD performance. The introduction of SATA 6GB/sec channels also means that Sandy Bridge systems will be ready for SATA 6GB/sec SSDs when the drive controllers are finally ready sometime early this year. It is a shame that Intel hasn't gone down the same path as AMD and moved wholesale to SATA 6GB/sec ports but the two channels are at least a step in the right direction, and motherboard manufacturers are also using Marvell SATA controllers to bulk out the number of ports.

What next?

As we've mentioned, Sandy Bridge is all about the introduction of a new CPU architecture. Most performance differences are going to be due to graphics, and our testing against the current top of the range Gulftown processor shows that our test Core i7 2600K CPU is still a step below the performance of the six core i7-980x CPU and its triple channel memory. In Cinebench 11 for example, the 2600K scored 6.83, well below the 980x with 8.95 but close to results that we have for the Core i7-930 processor.

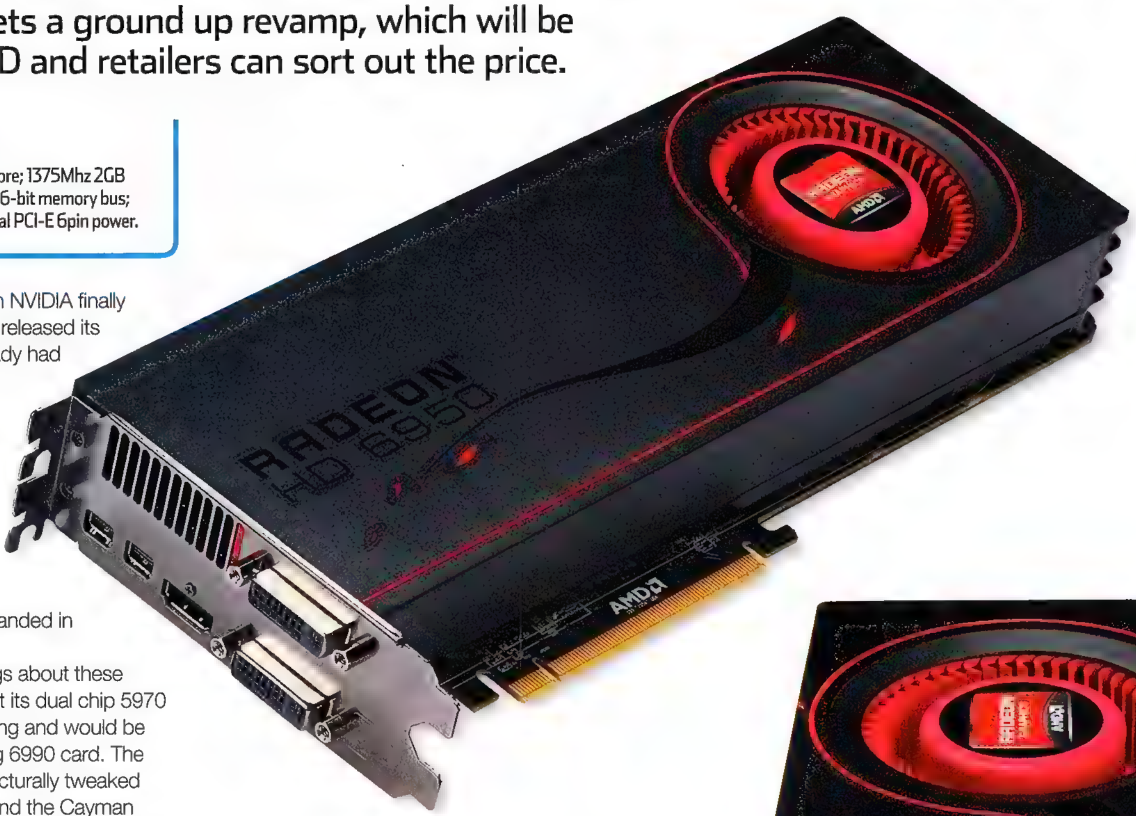
Sandy Bridge is here, and for now at least it still shows Intel as the company to beat in the CPU space. Once more processors start to flow into the market we'll take a look at how different models of the Second Generation Core i7 compare to each other, and investigate just how well the processor overclocks. As for integrated graphics performance, let's just say that you won't be moving away from discrete graphics for gaming anytime soon. **JG**



AMD RADEON 6970 AND

The RADEON gets a ground up revamp, which will be awesome if AMD and retailers can sort out the price.

Street Price TBC **Supplier** AMD
Website www.amd.com
Specifications 40nm, 880MHz Core; 1375Mhz 2GB GDDR5 memory; 'Cayman' core; 256-bit memory bus; dual slot PCB with active cooling; dual PCI-E 6pin power.



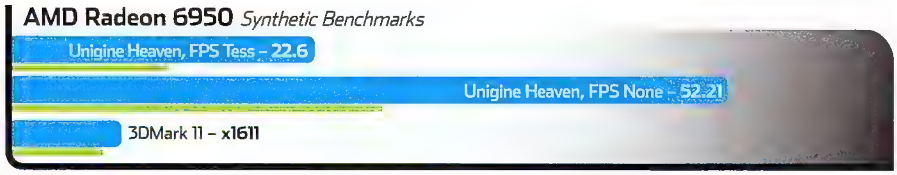
2010 was a year in which NVIDIA finally got its act together and released its DirectX 11 lineup. AMD already had the jump with the RADEON 5000 series, and it closed out the year with the revamped 6000 series. We've already examined the midrange AMD RADEON HD 6850 and 6870, and now the higher end RADEON 6970 and 6950 'Cayman' cards have landed in the Atomic labs.

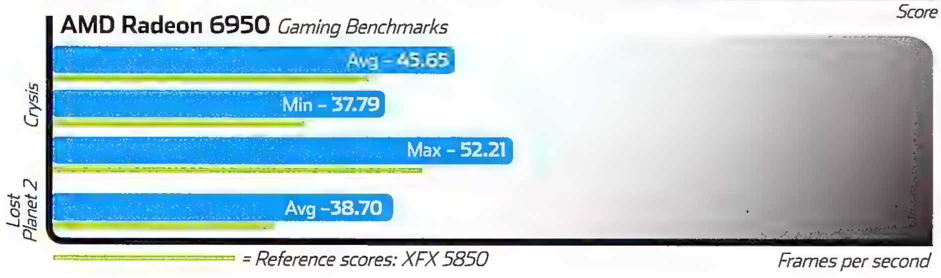
During pre-release briefings about these cards AMD made it clear that its dual chip 5970 card was still its fastest offering and would be until it unveiled the upcoming 6990 card. The 6850 and 6870 were architecturally tweaked to improve on weak areas, and the Cayman core takes this even further with a fundamental change to the shader units themselves.

Since the R600 series ATI cards have been based around AMD's Very Long Instruction Word 5 (VLIW5) design. In this each shader block is built of four simple and one complex unit (hence the 5), which could all operate at once but rarely did – instead loads tended to run either four or one at a time. There was nothing wrong with this design, but as the size of its GPU increased AMD realised that it needed to do something to save space.

It arrived at a new shader design called VLIW4, which as you may guess has four shaders. Each of these is a 'simple' shader in the old terms, yet they can work together to handle the loads once meant for complex shaders.

Besides the shader tweaks, AMD has also played with the tessellation units on the GPU. This is the company's eighth generation tesselator, and while the GPU still has less grunt, AMD profess it to be enough. The problem with heavy tessellation is that it generates needlessly power-hungry workloads by generating computationally painful but invisible artifacts like subpixel triangles. This seemed an argument aimed largely at NVIDIA and its heavy pimping of tests like Unigine and Stone Giant. To this end AMD's architecture should perform well





6950

(roughly double that of last gen) up to a sweet spot, at which point the sheer number of tessellators in NVIDIA's architecture should pull away in tessellation performance.

One other major change with the Cayman cards is the enhanced power management that AMD has implemented. This can effectively clamp the GPU speed to a certain TDP, scaling speeds to stay within that design. This isn't something that comes into play often when gaming; it is much more designed to help the card cope better with heavy GPGPU workloads (such as high performance computing and Furmark style testing).

When it comes to actual gaming performance don't expect records to tumble. The focus seems to have been on improving performance in AMD's weak areas rather than delivering an overall boost. If we look at the unigine results we can see that while NVIDIA still holds the tessellation lead, AMD's promise of a doubling from previous generations has borne out.

> While it hasn't claimed any speed records, AMD has produced a very robust couple of cards in the form of the 6970 and 6950.

When we look at Crysis we see performance that matches AMD's marketing. The 6970 is slightly behind the GTX 580, scoring over 51fps at very high settings. The 6950 is equally no slouch, managing 45.65 fps in the same test. This really is ample performance for all but the most power hungry of users, and while NVIDIA's GTX 580 holds the performance crown in this generation we're still talking about a level of performance that will only really seem inferior when using multiple monitor 3D setups.

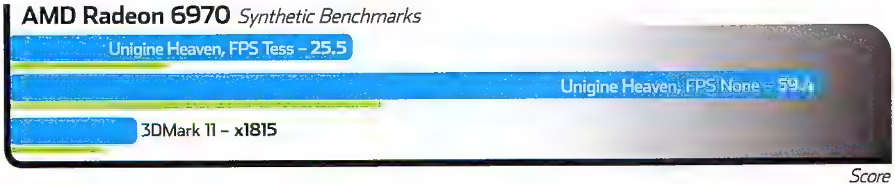
We've decided to shelve 3DMark Vantage and have moved onto the newly released 3DMark11 for our testing this month. This has largely been done because 3DMark11 moves away from the bizarre use of NVIDIA's PhysX and instead uses DirectCompute for physics and the like. This makes results between NVIDIA and AMD architecture much more relevant than it was last generation.

In the extreme 3DMark11 tests the 6970 sat 150 points behind the GTX 580, with the 6950 coming in third. The performance delivered by the 6950 was close to the previous generation RADEON HD 5970 in both of these tests, largely due to the improvements in tessellation seen between the generations.

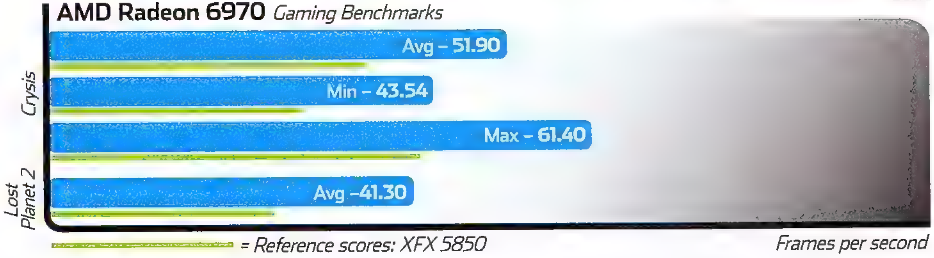
While it hasn't claimed any speed records, AMD has produced a very robust couple of cards in the form of the 6970 and 6950. They manage to deliver highly competitive performance that improves upon previous AMD offerings, but by introducing an architectural revamp on a 40nm process the company has managed to deliver high performance at what should be a great price.

We say that because at the time of writing the pricing of these cards is a mess. AMD announced that the 6970 would have an RRP of $419 and the 6950 would be $339. At these prices both cards would be firmly headed for hot awards, but actual retail prices are much higher, which pushes the 6970 into the same bracket as the GeForce GTX 580 – and at that price the speedier 580 is the no brainer decision. If you can find these cards for the RRP then consider them Hot, but otherwise we're going to have to hold back our final judgment until the ridiculous pricing situation is sorted out. **JG**

AMD Radeon 6970 *Synthetic Benchmarks*



AMD Radeon 6970 *Gaming Benchmarks*



Performance Not the fastest cards, but still bloody quick	91
Bundle Still just reference designs for now.	70
Value Could be fantastic or awful.	?
Build A definite improvement on past cards.	89
Overall Still waiting on a real price - until then this is up in the air...	??%

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OCZ RevoDrive x2 240GB

Very expensive, but boy, oh, boy do you get what you pay for.

Street Price $780 **Supplier** OCZ
Website www.ocztechnology.com
Specifications x4 PCI-Express Card; Silicon Image RAID 0; 4x Sandforce 1200 controllers; 240GB MLC flash.

OCZ has emerged as one of the clear innovators in the SSD world. Its initial foray into PCI-Express based SSDs wasn't great, but the recent RevoDrive – a PCI-Express card that sports two raided SSDs – impressed with speeds above and beyond that found on Serial ATA connections. We did worry that the drive lacked TRIM support, and showed a drop in speed once filled, but speeds were still in excess of what we see in SATA based SSDs.

The RevoDrive X2 follows hot on the heels of the RevoDrive, and uses the same basic x4 PCI-Express card design, but adds a small daughterboard that contains two more SSDs, bringing the total number of drives in the RevoDrive's RAID 0 array to four. Each drive features a Sandforce 1200 controller chip and 60GB of MLC flash memory, all running via a Silicon Image controller.

We tested the RevoDrive x2 using the AS SSD benchmark. This gives more granularity than other I/O benchmarks, and shows more than just burst reads and writes. The RevoDrive x2 managed sequential read speeds of 661MB/s (the first RevoDrive scored 499MB/s) and writes of 342MB/sec, while the threaded tests showed reads of 427MB/sec and writes of 304MB/s. These are by far the fastest speeds we have seen, and while the increase over the original RevoDrive isn't enormous, it's still significant enough to show the advantages of the Quad raid implementation.

We followed up this testing by filling the drive with junk data and then deleting and retesting. The results barely changed, and we didn't see the performance hit experienced with the RevoDrive. Instead it seems that the Sandforce controllers are now properly managing empty space and garbage collection duties.

The RevoDrive x2 is certainly the fastest consumer SSD out there, but it comes with a pricetag to match. While the pricing of the dual channel RevoDrive makes it a very tempting alternative to SATA based SSDs, the extra premium for this quad offering makes it a harder value proposition. That said, only this and OCZ's proprietarily-cabled IBIS drives are capable of these speeds, and this is a much saner option than the IBIS. **JG**

Overall
It's expensive, but this is the fastest consumer SSD out there.

91%

Thortech Thunderbolt Plus 800W

GEIL enters the PSU space with this top little unit.

Street Price TBC **Supplier** GEIL
Website www.thortechpower.com
Specifications Captive: 24-pin, 8-pin, 2x 6+2 pin PCI-E Modular: 8 x SATA, 4 x xMolex, 1 x 6+2pin PCI-E; 80 Plus Gold certified; 5.25in front panel readout.

If you haven't heard of Thortech before, it's the newly minted Power Supply brand of stalwart RAM manufacturer GEIL. The Thortech Thunderbolt Plus 800W is their first foray into the market. This is an 80 Plus Gold certified PSU, which notably comes with a 5.25in front panel readout, designed to give you a close idea of how the PSU is faring.

This front panel includes such information as voltage and wattage draws on each rail, real-time efficiency and also provides for fan control and temperature monitoring.

While the front panel is Thortech's main point of difference, the PSU itself is also nothing to be sneezed at. It is of a modular design, shipping with the normal array of captive ATX and PCI-E power cables as well as a bag with separate cabling for drives and the like. Our only negative comment about this is that the cable sleeving ends a few centimeters short of the actual plugs. This is more an aesthetic than a technical problem, but we do wonder why GEIL didn't sleeve the entire cable.

Otherwise, we were impressed. This is a great performer – despite the fact that most of the salient information is displayed on the front panel, we still double checked with a multimeter. Not only is the info pretty accurate, the unit itself was great. It delivered constant power on all the rails, and didn't struggle under load.

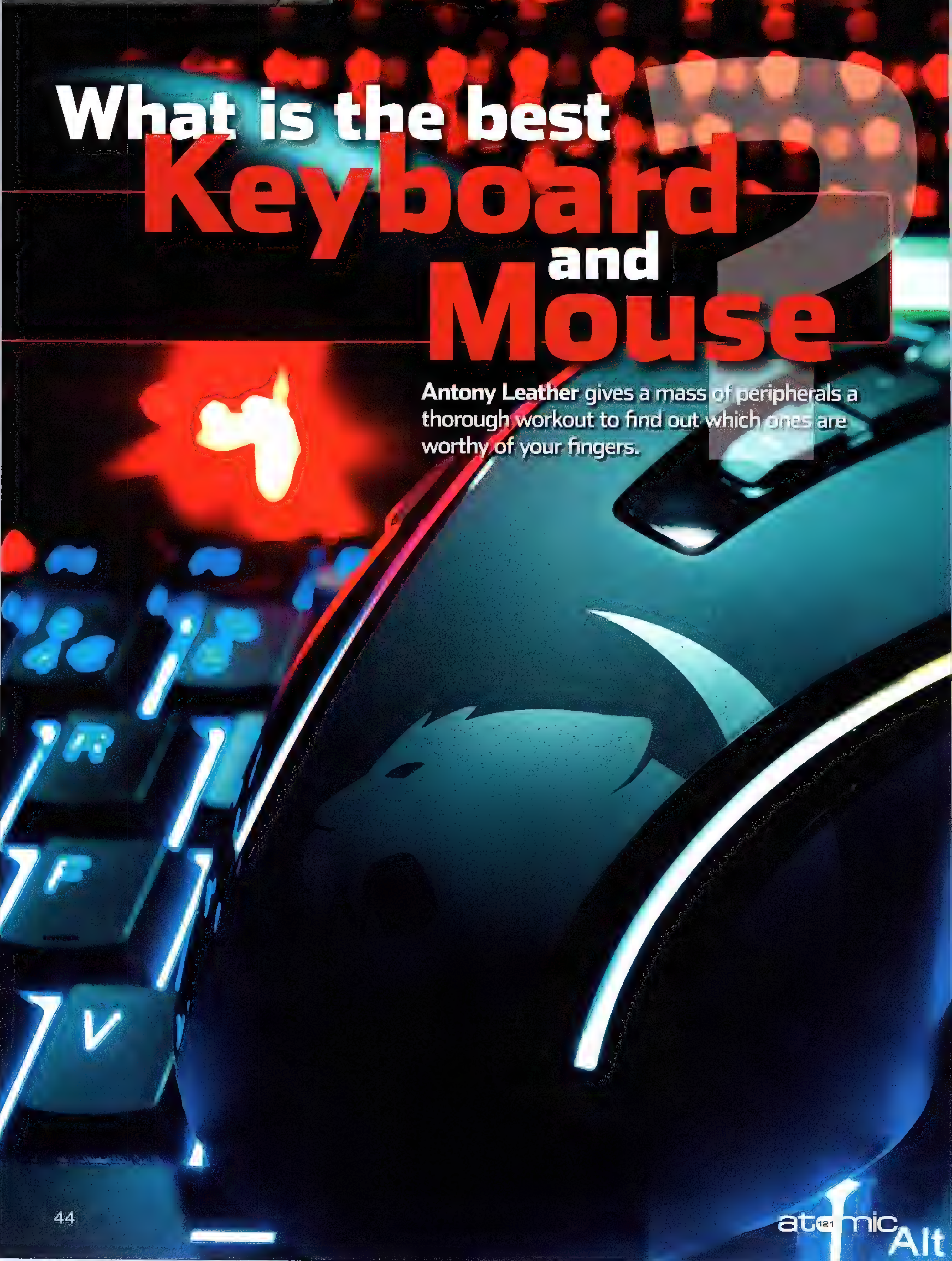
At the time of writing local pricing was yet to be confirmed, but the US RRP for the Thunderbolt Plus was $240. This premium pricing will mean that the PSU isn't for everyone, but Thortech has at least provided hardware that backs it up. The PSU a highly efficient performer, and the front panel addition is pretty damn cool. This is certainly a great debut in a crowded market from GEIL. **JG**

Overall
A solid PSU debut from a famed memory company.

93%

What is the best Keyboard and Mouse?

Antony Leather gives a mass of peripherals a thorough workout to find out which ones are worthy of your fingers.



There's little doubt that a responsive and well-designed mouse and keyboard can give you an edge. Features such as 1,000Hz polling rates and easily accessible thumb buttons can make a difference to how well you react to the challenges presented by your favourite games. However, one aspect that's often overlooked amid the plethora of features and gimmicks is the level of comfort your keyboard and mouse offer. We've had some shocking peripherals arrive in the Atomic lab over the years that would probably put you off gaming completely.

This isn't to say that all features are useless, though, and some of the six gaming mice and ten gaming keyboards we've looked at in this month's Head2Head have some genuinely useful additions. For this reason, we've rounded up a selection of both old and new peripherals, all claiming to be worthy of your cash. If you're in the market for a new keyboard or mouse, then this is one Head2Head you must read.

MICE

Arctic M571

Street Price $20
Product page www.arctic-cooling.com

The M571 is the cheapest mouse in this Head2Head – it's hard to get locally but it can be bought overseas for around $30, and is part of a new line of peripherals from the company formerly known as Arctic Cooling.

Our first impressions of the M571 weren't great. The mouse is designed to be held in the palm rather than with your fingers, so it rises a fair distance off the desk, with the left peak much higher the other mice on test. Despite making a good effort to support your thumb and fingers, it isn't very comfortable and has some major design issues.

Firstly, the thumb buttons are located more than an inch above where your thumb rests naturally. We're in favour of thumb buttons designed and positioned so that they can't be depressed accidentally, but the M571's thumb buttons are placed in such a way that using them is awkward at best. This resulted in us being killed a lot when we tried and failed to use the buttons for quick melee attacks in Bad Company 2.

Our second gripe is with the overall feel of the mouse. The huge arch makes the mouse feel cumbersome, despite the fact that it's quite light, and it didn't really fit our hands very well. The M571 comes bundled with weights, so you can beef it up if you find it too light.

However, it's poor construction that really lets the M571 down. The mouse body is flanked by large silver sections that support your thumb, ring and little fingers, but the silver sections don't quite align with the rest of the body, resulting in sharp protruding edges which might be welcome on a kitchen knife – but don't really work on a mouse. On top of that, the entire mouse wobbles from front to back. On closer inspection, we found that one of the large plastic feet had fallen off, which we might expect after a few years of use, not a few hours.

There's a sensitivity toggle located behind the scroll wheel, letting you choose between 800dpi, 1,600dpi and 2,400dpi. However, as there's no software, adjustment is otherwise limited. There's also a quick-fire button next to the scroll wheel that mimics repeated use of the left mouse button, and is just as quick as pressing it manually.

The M571's issues made for a disappointing gaming experience. It was nowhere near as pleasant and natural to use as the Moinix Naos 3200 or the Razer Imperator. The tracking appeared to be all over the place – moving the mouse horizontally saw the screen track diagonally, instead of from left to right.

The M571 is cheap but unfortunately this shows in its design and build. We've seen mice that cost the same amount perform better, so the low price is no excuse. If you're on a tight budget then we recommend opting for a cheaper still Microsoft Intellimouse instead.

Overall
Cheap, but certainly not cheerful. One to miss.
44%

Cyborg R.A.T. 3

Street Price $80
Manufacturer www.cyborggaming.com

Cyborg's R.A.T. series of mice have created quite a stir among gamers. They look as though they were designed to break the sound barrier, and are usually ridiculously adjustable. However, as the cheapest model in the R.A.T.-series, the R.A.T. 3 lacks the adjustable surfaces of its more ludicrous cousins.

Most of us find that the R.A.T.-series mice are far from comfortable until you adjust the surfaces to suit, so the omission of this feature places the R.A.T. 3 at quite a disadvantage. It is awkward and nowhere near as pleasant to hold as most of the other mice on test. In particular, the right mouse button protrudes slightly, resulting in a sharp ridge that catches your ring finger. Despite the thumb buttons being sensibly placed, they're jagged and your little finger is left to drag across the desk. The palm support is raised too high, so your hand is forced into an unnatural pyramid shape.

A more worrying issue is the scroll wheel. It has a pleasant degree of resistance, but when we tried scrolling quickly to the end of a webpage, it stuttered and refused to move the page down, as though the mechanism was broken. This is a design flaw that would drive most people mad if they were using it on a daily basis.

The software provided with the R.A.T. 3 allows you to alter the four dpi sensitivity modes, which are controlled by way of a rocker behind the scroll wheel, from 400dpi to 3,200dpi. The current sensitivity is indicated by lights on a protruding wing next to your index finger. On the other side of this wing is a mode button. This toggles between different pre-configured profiles. While it allows for independent X and Y axis adjustment – an option that's missing from the main settings tab – the mode button is stiff to use.

The R.A.T. 3 was fairly good in games, with responsive and predictable movements to which you quickly become accustomed. However, we couldn't get around the comfort issues and were constantly reminded of the prickly thing in our hand by the palm rest, protruding right hand button and jagged thumb buttons.

The R.A.T. 7 is just about bearable thanks to its adjustable surfaces. In contrast, the R.A.T. 3 is flawed from the start as it has no physical adjustment and simply isn't as comfortable as the other mice on test. Combined with the mediocre amount of adjustments provided in the software, we can't recommend this rodent.

Overall
An uncomfortable rodent that's not as adjustable as it looks.
56%

Mionix Naos 3200

Street Price $80
Product page www.mionix.net

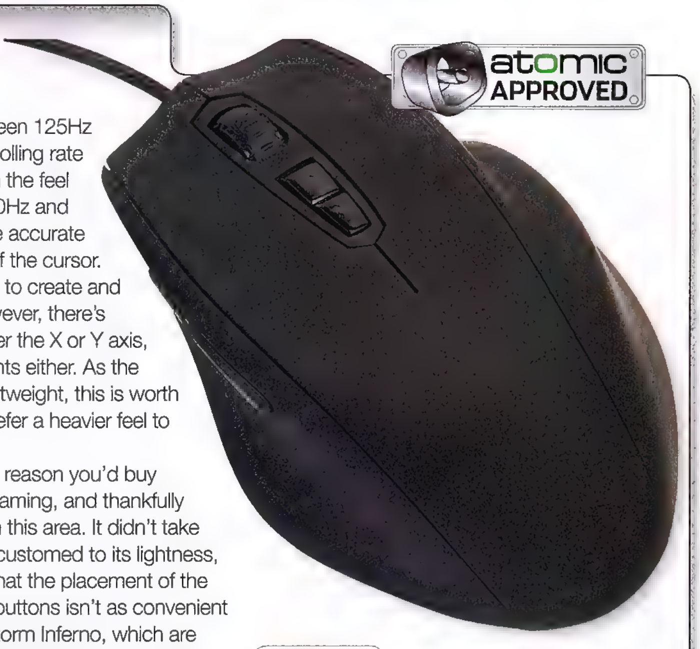
The Naos 3200 has a 2m braided cable and the smooth, arched back is incredibly comfortable. Gently sloping scoops on either side make sure that your thumb, ring and little fingers are supported above the desk and not dragging across it. Thankfully, as the mouse is fairly long, you can alter the position of your hand to suit the position of the thumb buttons.

However, the Naos 3200 lacks the range of adjustment offered by other mice in the Naos range. On-the-fly dpi adjustment can only be switched between 800dpi, 1600dpi and 3200dpi using the reasonably accessible buttons behind the three-button scroll wheel. We found 800dpi to be spot on for sensitive sniping and 3,200dpi just right for running around. The Naos 3200 works well out of the box though; sensitivity adjustment is good and Windows 7 automatically installs a driver when you plug in the mouse.

However, using the software downloadable from Mionix's website, you're also able to adjust the pointer speed and acceleration, toggle the lights on and off – these glow according to the dpi setting – and adjust the USB polling rate between 125Hz and 1KHz. The USB polling rate has a major impact on the feel of the mouse, with 500Hz and 1KHz providing a more accurate and solid movement of the cursor. There's also the option to create and save macros too. However, there's no adjustment for either the X or Y axis, and there are no weights either. As the Naos 3200 is fairly lightweight, this is worth remembering if you prefer a heavier feel to your mouse.

Of course, the main reason you'd buy the Naos 3200 is for gaming, and thankfully it doesn't disappoint in this area. It didn't take us long to become accustomed to its lightness, although we'd argue that the placement of the thumb and sensitivity buttons isn't as convenient as those on the CM Storm Inferno, which are positioned practically underneath your digits.

The Naos 3200 is well priced and much better than a generic mouse if you play a lot of games. It's also worth noting that while old favourites such as the Logitech MX518 are available for less, they lack many features, such as high USB polling rates. As a result, the Naos 3200 is a great buy.



atomic APPROVED

Overall
A solid gaming mouse with good adjustment options.

87%

Ozone Radon 5K

Street Price $75
Manufacturer www.ozonegaming.com

The Ozone Radon 5K is in the middle of the price range of the mice in this Head2Head. The first thing we noticed about it was it's rather odd size; it's far too tall for its relatively short length. This means that its peak, which rises just behind your knuckles, digs into your palm in an unpleasant way. It pushes your hand into an arched position and places strain on your wrist.

Because the Radon 5K doesn't fit into your hand naturally, you're left feeling that you aren't in complete control. Perhaps the worst aspect of the design is the lack of support it provides for your ring and little fingers. The right edge of the mouse actually bends in under itself as it meets the desk, so our little finger was constantly being trapped between the mouse and the desk.

Two buttons are located along the join between the side and upper surfaces of the mouse, very close to your thumb. They are covered in an unpleasant ridged rubber grip that feels like the tyre of a mountain bike, but not as solidly constructed. The other buttons feel much firmer and include a dpi sensitivity rocker switch behind the scroll wheel. The Radon 5K is very lightweight, yet feels very solid – rubbery thumb buttons aside. Ozone bundles some optional weights too, so if the mouse feels like it's been on too much of a diet, you can adjust its weight. Large Teflon feet allow it to move almost effortlessly across your desk or mouse mat.

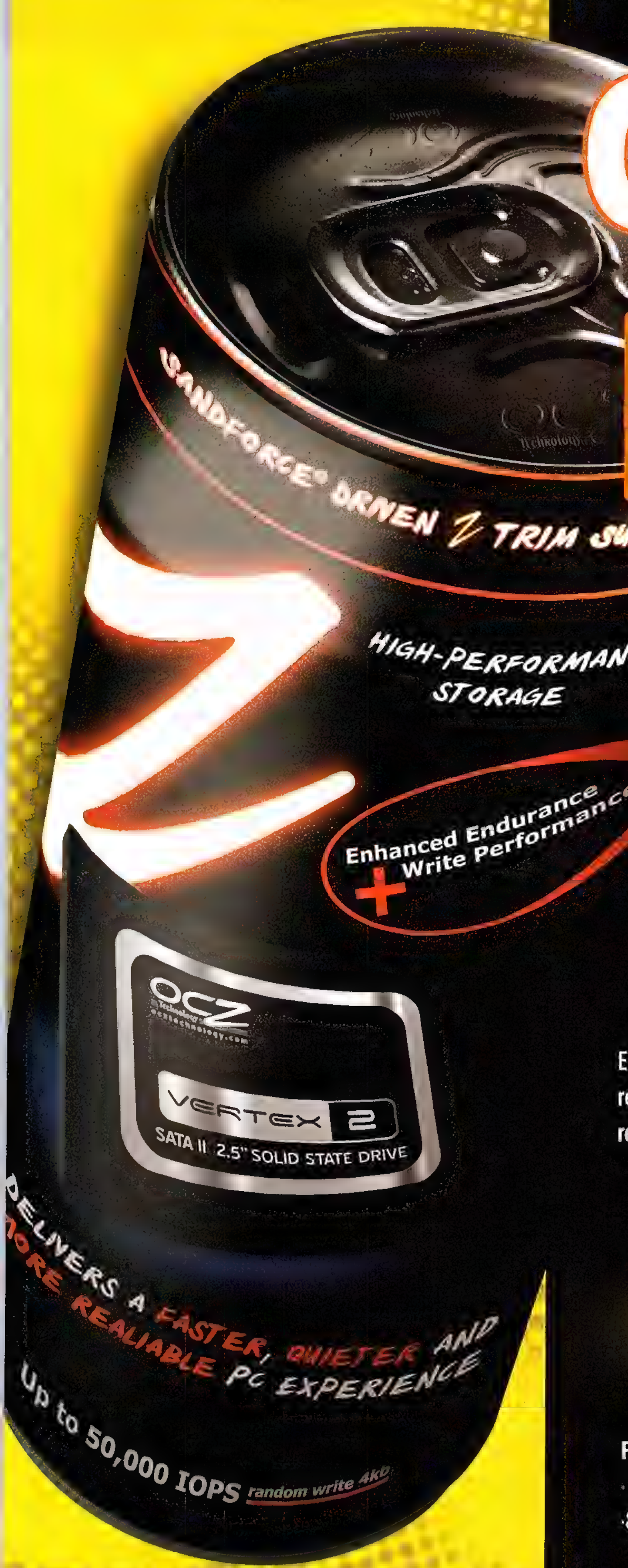
For adjustment, you're able to tweak the sensitivity between 100dpi and 5,600dpi with the selected sensitivity indicated by lights above the thumb buttons. You can also create profiles and alter the USB polling rate to either 125Hz, 250Hz, 500Hz or 1KHz.

During gaming, the Radon 5K is responsive and precise. However, its bulbous shape means it isn't very comfortable. It also seems to be slightly biased on the X axis. Whether this is due to the shape of the mouse or the sensor we aren't entirely sure, but there's little you can do as there's no separate axis adjustment.

The Radon 5K isn't as flawed as the Arctic M571-L or the Cyborg R.A.T 3, but it's in no way as rounded and pleasant to use as the Razer Imperator or Mionix Naos 3200. As it costs close to the same as the latter and is much less adjustable, the Radon 5K won't be finding its way onto our shopping list any time soon.

Overall
A decent showing at an average price, but fails to really stand out.

61%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Serving Size: 40-480GB

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Write Up to	275MB/s
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Slim Design	2.5"
Lightweight	77g
Shock Resistant	Up to 1500G
RAID Support	Yes
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Accessory	3.5" Desktop Bracket

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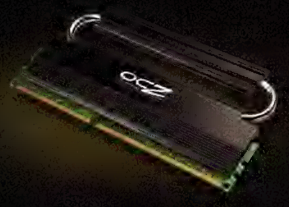

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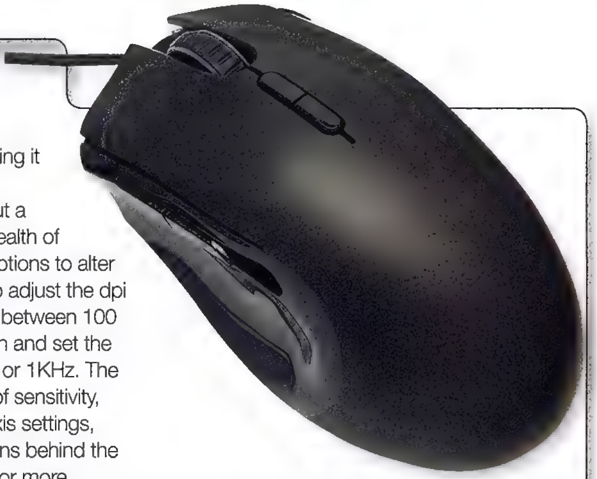
Razer Imperator



Street Price $145
Manufacturer www.razerzone.com

Our first grapple with the Imperator (issue 110) left us cold. We've included the mouse in this Head2Head to determine how it stacks up against the new kids on the block, and to have a look at it with a fresh pair of eyes. One thing is certain – the Imperator still has one of the coolest features we've seen on a mouse: adjustable thumb buttons.

Given that so many mice we've seen are ruined by poorly located thumb buttons, these are very welcome. The Imperator also executes the concept of an adjustable mouse much more convincingly than other mice such as the Cyborg R.A.T. 7.

The only potential downside we can see to the thumb buttons is their general location. They sit slightly above where most people's thumbs naturally rest, unlike the thumb buttons of the CM Storm Inferno (issue 118), which are located directly underneath your thumb for super-quick access. The latter might be preferred by some people, but if you're worried about accidentally pressing buttons, the Imperator might be for you. It's also very sound ergonomically, and we found it comfortable to use whether holding it in our palm or with our fingertips.

There's no included software, but a downloadable utility allows for a wealth of adjustment. As well as the usual options to alter button assignments, you're able to adjust the dpi sensitivity of both the X and Y axis between 100 and 5,600dpi, alter the acceleration and set the USB polling rate to 125Hz, 500Hz or 1KHz. The utility also boasts up to five levels of sensitivity, again with independent X and Y axis settings, which can be selected using buttons behind the scroll wheel. We could hardly ask for more.

All these adjustment options can feel rather overwhelming, but an hour or two spent tweaking them really pays off. A slight bias to the X axis helped to maintain balance in fast-paced shooters, although raising one edge even slightly off our desk resulted in the Imperator not tracking properly. If you use your mouse lightly and keep it flat, this won't be a problem, but those prone to bouncing it around during heated firefights might want to look elsewhere.

In games, the Imperator was quick and responsive. Having the thumb buttons conveniently placed was a real boon too, but we found the sensitivity buttons to be a little too far back. The glossy, plastic surface also clings to your fingers, and we found that the thumb and little-finger scoops felt clammy after long gaming sessions.

Aside from those minor niggles, the Imperator is a fantastic mouse, with plenty of software-based configuration too. The only significant bone of contention is the price.

Overall
The adjustable thumb buttons almost make it worth the cost. Almost.
85%

Roccat Kone+

Street Price $112
Manufacturer www.roccat.org

If there were a prize for size, weight and features, the Roccat Kone+ would bully all the other mice off the podium. It's deceptively huge, and makes the Razer Imperator and Cyborg R.A.T 3 look tiny. It's also the heaviest mouse on test at 126g, and if this isn't enough, Roccat bundles it with four 5g weights.

Unfortunately, despite its size, there are no scoops for your ring and little fingers, so they're left to drag along the desk. Given the size of the Kone+, it's a bizarre omission.

It isn't all bad news though. The thumb and dpi sensitivity toggle buttons are well located and the scroll wheel has a good amount of resistance. It is also able to move sideways, providing two additional buttons that scroll to the left and right in certain applications.

It's when you fire up the bundled software that that things really get going; there's what can only be described as an insane amount of adjustment. As an example, there are up to five dpi settings, with the option of using just two, three or four or all of them set between 100dpi and 6,000dpi in 100dpi increments. Heading into the advanced section reveals yet more tweakable options. You can set the scroll speed for both vertical and horizontal scrolling, and also the height at which the sensor will stop tracking.

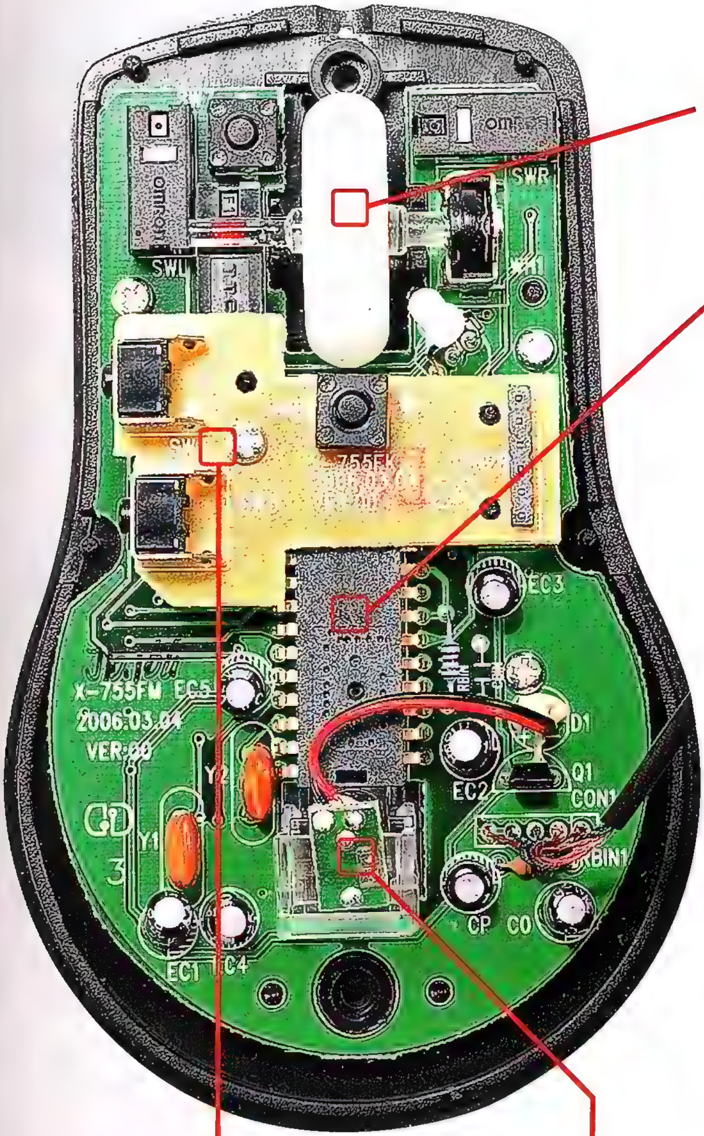
A feature called the Tracking Control Unit is supposedly able to analyse the surface of your desk or mouse mat to optimise tracking, but this didn't seem to make much difference to tracking between our textured mouse mat and glossy desk. The Kone+ includes one more interesting addition called Easyshift. Activated by pressing a pre-specified button on the mouse, Easyshift works in the same way as the shift key on your keyboard. When pressed, it provides each button with an additional assignment. This is a great feature and a lot more usable than some of the terrible ten-plus button mice we've seen over the years. Finally, you're also able to customise two light strips at the edges of the mouse. Each of these can be set to one of 33 different colours, use one of four different effects – or just switched off.

In games, the Kone+ was easily one of the better-feeling mice in this group. Once we'd played with the plethora of options, it felt very precise and accurate. Despite its weight and size, it was fairly nimble across the desk thanks to its smooth feet. However, we found that our ring and little fingers were left to dangle, which was annoying.

The Kone + is keenly priced given its epically long list of tweaks and customisation. However, think carefully about how you hold your mouse and whether you need plenty of finger support before reaching for your wallet.

Overall
Big, heavy and feature-packed, but it's not for everyone.
79%

ANATOMY OF A MOUSE



SCROLL WHEEL
The scroll wheel has its own infrared LED sensor system, enabling the processor to track the speed and direction of the wheel's rotation.

CMOS SENSOR
A small array of light sensors (30 x 30 pixels in the Agilent ADNS-6010 system used in premium Logitech and Razer mice). The more receptive the CMOS sensor, the more sensitive the mouse, and the more able it will be to cope with precise movement or high movement speeds.

PROCESSOR
The brains of the outfit (under the PCB in this photo). The speed and capabilities of the processor will define how accurately it can track speed and position from the frames captured by the CMOS sensor. The processor will also handle ancillary tasks, such as determining when the mouse is lifted off the surface and repositioned (as often happens during frantic action in a game).

LED/LASER
Illuminates the surface beneath the mouse with an intense beam of light (this may be on a frequency that's invisible to the human eye). A laser provides an intense, short-wave beam of light, which allows the CMOS sensor to resolve more detail.

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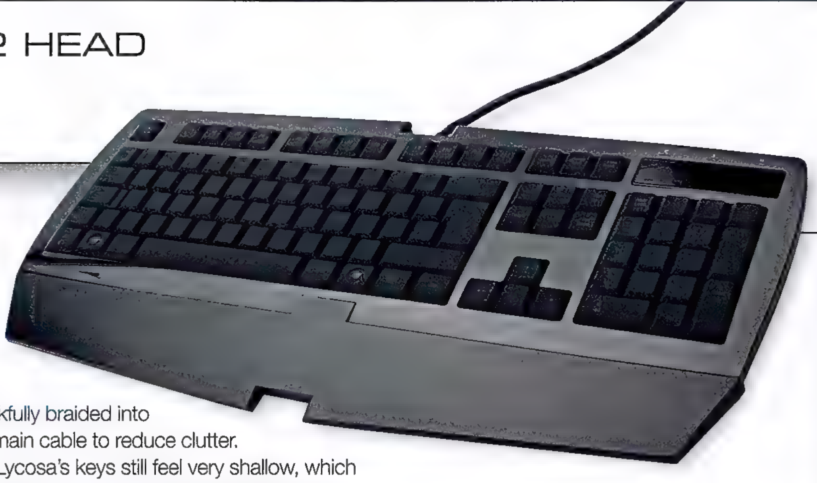
KEYBOARDS

Razer Lycosa



Street Price $90
Product page www.razergaming.com

Razer's Arctosa keyboard may have been one of the more solid Razer products we've looked at (issue 101), but it still left a fair amount to be desired. It was very flat, even fully raised with what little height adjustment it had. The keys were also very low profile and barely rose above the shell of the keyboard. The Lycosa is similar to the Arctosa in many ways, but it offers several refinements.

One improvement is the addition of backlit keys, which make gaming in low light much easier. If a glowing keyboard isn't to your liking, you can choose to just illuminate the WASD keys, which looks quite funky, or turn off the lights altogether. Unfortunately, the lettering on the keys appears grey when the lights are off, making it hard to read against the dark rubber finish. If you're unable to touch-type, finding the right keys isn't quite as easy as it should be.

There's a USB port, and 3.5mm microphone and headphone jacks at the top of the keyboard too, which are a nice addition. These hook up to your PC via 3.5mm jacks and a second USB connection, which is thankfully braided into the main cable to reduce clutter. The Lycosa's keys still feel very shallow, which is also one of our main complaints about the Arctosa, but a non-slip rubber coating makes them a little easier to hit.

Another bone of contention is the media control pad. This is touch-responsive and usually works quite well. However, the lighting underneath the pad is very dim and it can be hard to read the controls even in a dark room.

The Lycosa includes the same large wrist rest as the Arctosa and while the long, sloping design looks good, it's not the most comfortable. The rest doesn't quite meet your wrist and can't be extended.

The keys are fairly responsive, with relatively short, snappy keystrokes, which feel similar to some mechanical key-equipped keyboards, although thankfully they're much quieter. It's comfortable to use for long periods, and a pleasant keyboard for typing, despite its shallow keystrokes and body – although the height of the keys can take some getting used to.

In games, however, the Lycosa was a little strenuous to use. The low-lying keys act in combination with the flatness of the keyboard to upset the natural position of our hands. Our hands felt more tired after a few hours with the Lycosa than they did with other keyboards.

Overally, it's the very reasonable price that most appeals about the Lycosa, provided you can tolerate the low-lying keys.

Overall
The price is right, but it's not as comfortable as we'd like.
74%

SteelSeries Shift

Street Price $130
Manufacturer www.steelseries.com

SteelSeries' new keyboard, the Shift, is based on the same concept as the Zboard, which has a removable keyset that can be replaced with keys suited specifically to certain games. Additional keysets with altered key layouts are available for around $30, but given that avid StarCraft II and World of Warcraft gamers usually put in a lot of hours, this customisation is probably a good investment – if it works.

The Shift is beefier than the Zboard and not only includes a huge wrist rest, but also has large, adjustable legs that alter the height to three levels, all of which are pleasant to use. The wrist rest may be large, but it only just reaches beyond your palm. The Shift is still very comfortable, mostly due to the keys being well spaced – unlike, for example, the Logitech keyboards, which have a slightly smaller layout and feel a little cramped. There are two USB 2 ports, and headphone and microphone pass-through jacks located at the top of the keyboard.

The keys are fantastic to use, with a responsiveness that's very close to that offered by mechanical switches, but without the noise. SteelSeries has also built in three different levels of key resistance.

The Shift is clearly focused on the LAN gamer market and therefore the swappable keysets can be folded. However, one fold crosses the spacebar and as such, it has been split in two. The gap is only around 5mm, but it was incredibly annoying if you don't touch-type – our fingers continually landed on the gap, resulting in confused pauses and lots of double spaces.

If you like using keyboard shortcuts, though, the Shift is definitely for you. There are 11 dedicated shortcut keys and the provided software also allows you to customise practically every key with up to four separate layers, which you can then switch between. In short, you'll probably run out of hard disk space for programs before you run out of shortcut keys for them.

In games, the Shift was brilliant and thankfully the two spacebars weren't an issue when using the WASD keys. In addition, the Shift was very responsive, although we found the primary key area was slightly compressed.

The Shift is nearly a fantastic keyboard but it's ultimately let down by a few niggles. With a few adjustments the Shift could be a winner, but it sadly isn't there yet.

Overall
Lots of customisation options, but not quite polished enough.
77%

Roccat Arvo

Street Price $80
Product page www.roccat.org

The Arvo is Roccat's attempt at a compact gaming keyboard, and it's come out at a mere 40cm wide. Sadly though, this means that Roccat has had to mess around with the layout to fit everything in, and the result is pretty dramatic.

The escape and function keys practically hang off the top edge of the Arvo, but the most controversial change is the removal of independent arrow, Home, Insert and Delete keys – these have all been integrated into the numberpad. It's not disastrous, but it means that you need a button to shift between the two modes and can't access both at the same time. This can be enormously frustrating, depending on the kind of work you do. It also has a dramatic effect on the Arvo's suitability for simulation games such as Arma II or Flight Simulator X.

Roccat has included three additional function keys at the base of the keyboard and these can be easily loaded up with macros. However, given the Arvo's flaws, this feels like a tick-box inclusion to pad out the packaging blurb, rather than a redeeming feature.

The compromises that Roccat has had to make due to the Arvo's size are a shame too, since it's actually a great keyboard for typing. The keys have relatively short strokes and offer very little resistance, with a sharp, snappy feel to boot.Unfortunately, that doesn't balance out the other flaws, or the fact that the keys felt small, even though they're regularly sized. Needless to say, the fact that the Arvo is apparently ghosting-free was the least of our concerns.

Despite its size, the Arvo stayed firmly planted on our desk thanks to the huge rubber pads underneath that keep it rooted in place. Roccat also makes the odd claim that the base is made of metal to provide durability against 'those little temper tantrums'. Unfortunately, the metal plate must be hidden inside the chassis, as the base on our model was definitely plastic.

While we can appreciate the need for a small keyboard, the compromises worked into the Arvo are too extensive for our liking. The dual-mode numberpad is a terrible idea and should only be used in the most desperate of circumstances. Bluntly, if portability is honestly a primary concern for you when you're buying a keyboard, then you're better off buying a bigger carry bag than forking out for the Arvo.

Overall
A classic case of usablility sacrificed for portability.
51%

Logitech G110

Street Price $75
Manufacturer www.logitech.com.au

Logitech's G series keyboards may be the most lustworthy gaming keyboards on the market. The combination of ample macro keys, media controls, and backlit keys usually make them the cream of the crop. The G110 drops the LCD screen that's become synonymous with the brand, but thankfully it's awash with other features.

There are 12 macro keys located on the far left side of the keyboard, all of which can be assigned with up to three key combinations using the included software, and switched by way of the mode keys directly above – providing up to 36 individual commands in total. These keys can take some getting used to – our little finger kept reaching out for the Ctrl key and finding one of these instead.

As with previous models in the series, a Windows key locker is located at the top of the keyboard, preventing the Start Menu from being activated mid-game. Logitech has also included a basic on-board USB sound card with its own 3.5mm headphone and microphone jacks located to the left of the USB cable. Unfortunately, there's no way to use the G110 as a pass-through for your own sound card, and the on-board card is no Creative X-Fi, so you might have a tough choice to make.

Cleverly, the media controls on the G110, which include volume controls and track skipping buttons, work with whatever sound card is activated at the time. One option you do have is to use Windows' sound control panel to override the G110's meddling, by making your speakers the primary audio output device for games, while you use the G110's on-board sound for your microphone.

Next to the 3.5mm jacks is a USB 2 port that can power most external devices that don't require a plug socket. The backlit keys on the G110 are something special too. The lighting is crisp and subtle, and the colour is fully customisable. Unfortunately, while you can turn off the lights, there's no option to dim them.

Comfort-wise, the G110 has no major issues. A large removable wrist rest is included and the G110 has legs to alter the height to two levels. It's fairly flat, though, even at its maximum height setting, but the keys are quite pronounced to compensate.

The keys are great too. They're light, snappy and responsive, and very comfortable to use for long periods of typing. Despite having an extra two columns of keys, however, the G110 isn't huge. This has led to a slightly compressed primary key area and, as such, the keys feel slightly narrow. The WASD area in particular feels a little cramped while gaming.

At $75, the G110 is the least expensive keyboard on test. Combined with its list of features, it's a hard choice to ignore.

Overall
A good performer at a price that's hard to go past.
79%

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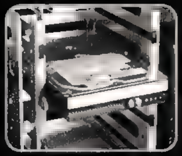
SILENT

Bay: 5.25" x5,(Can be convert to 3.5" internal x 3),
3.5" internal x10 (Can be convert to 2.5" x 5), 2.5" internal x 2
M/B: HPTX / E-ATX / ATX (Slide out M/B tray)
Fan: 3 x 140mm, 2 x 120mm
I/O Ports: USB 3.0 x 4 / E-SATA x 1 / HD Audio
Dim.: 235 x 620 x 635mm (W, H, D)
PCI: 11 Slots
Color: Silver / Black / All Black



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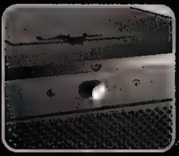

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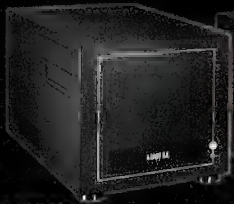
PC-8N
Bay: 5.25" x 4, 3.5" x 1,
3.5" internal x 3
2.5" internal x 1
M/B: ATX, M-ATX
Fan: 2 x 120mm
Dim. 210 x 450 x 490 (W, H, D)



PC-V352B
Bay: 5.25" x 2, 3.5" x 1,
3.5" internal x3
M/B: M-ATX, Mini ITX
Fan: 2 x 120mm, 1 x 80mm
I/O: USB3.0 x 2, E-SATA, HD Audio
Color: red / black / silver

PC-Q08
Bay: 5.25" x1, 3.5"internal x6
2.5" x 1
M/B: Mini ITX
Fan: 1 x 120mm, 1 x 140mm
I/O: USB3.0 x2, HD Audio
Color: red / black / silver

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Test Bench

DIY

T1
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Bay: Slim ODD x1, 3.5" internal x1
M/B: Mini ITX
Dim.: 520 x 300 x 485mm
Color: red / black / silver

T60
Bay: 5.25" x 2, 3.5" x 3, 2.5" x 2
M/B: ATX / M-ATX
PCI: 8 slots
Size: 351 x 330 x 400mm
Color: red / black / silver
Optional: USB3.0 x2, E-SATA, HD Audio

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Scorpion Technology(03)8561 3200 www.scorptec.com.au
NSW
Mwave (02)9649 6184 www.mwave.com.au
IJK (02)9745 0877 www.ijk.com.au
Corecomputers (02)9621 2875
AusPCMarket (02)9646 8000 www.auspcmarket.com.au
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IT Estate (02)9630 9630 www.itestate.com.au

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Umart (07)3369 3928 www.umart.com.au
ITSDirect (07)5408 5588 www.itsdirect.com.au
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Trinix Computers (08)9350 1600 www.trinix.com.au
TAS:
Tas Principal (03)6334 6677 www.principalcomputers.com.au

Distributor
mittoni
extreme technology distribution
www.mittoni.com.au
Melbourne Office: 1300 200 000
Sydney Office: 02 9646 3018

Logitech G510

Street Price $160
Manufacturer www.logitech.com.au

The G510 is yet another LCD-equipped keyboard from Logitech and, like the G110, is aimed at a niche marketplace that only Logitech's G series keyboards seem able to target. There are a few differences between it and other keyboards in the G series, though, despite its similar appearance and feel.

The G510 is clearly aimed at MMO and RTS fans, judging by the number of macro keys on offer. The G110 has 12 of them but the G510 goes all out with an overwhelming 18 macro keys. Again, there are three mode settings that triple the number of assignments, providing 54 different combinations before you even look at the macros for other keys.

The G510 features the standard Windows key locker, plus a similar USB sound card to that of the G110; again, this means that you won't be able to use it as a pass-through for your own sound card. This could be annoying if you've forked out for a good sound card, as you won't be able to take advantage of the G510's conveniently placed 3.5mm headphone and microphone jacks.

Strangely, the G510 doesn't include a USB port, which is disappointing considering the high price.

One of the main reasons most buyers consider Logitech's G series keyboards is to take advantage of the built-in LCD screens. Initially little more than a gimmick when they first appeared on the G15, they've since become very popular – thanks to their ability to show ammo or health levels, freeing up screen space. The list of games supported by the GamePanel is constantly on the rise, with some needing patches while others provide native support. The LCD can also function as a PC monitoring suite, showing CPU and RAM usage. With the aid of utilities such as EVGA's Precision, you can even check various system temperatures while gaming.

While the G110 backlight only lets you mix red and blue, the G510 is able to display the whole spectrum. The backlighting is of fixed intensity, but isn't too bright. In fact, it only shines through symbols on the keys and surrounding buttons.

There are plenty of media controls too, including play and stop controls, plus volume control and a dedicated mute button. Comfortwise, the G510 is flatter than the G110 even with its legs extended but the large wrist rest props up your hands enough to compensate. The keys are different too – the G110's were quick and snappy, while the G510 feels much smoother, like the keys on the Cyborg V5.

As with the G110, the G510 is an acquired taste. If macro keys are to your liking then it's a natural choice, but whether the screen and additional keys are worth the extra dosh is a difficult question, especially since you lose a USB port.

Overall
More macros than you can handle – but at a price.
78%

Filco Majestouch

Street Price $112
Manufacturer www.roccat.org

The Majestouch stands apart from all the other keyboards on test in that it uses a mechanical switch system rather than a membrane. This makes it more expensive, as it has so many individual components. At nearly $200, Diatec's Filco Majestouch is the most expensive keyboard on test, yet seems to lack most of the standard features. There's no backlighting, macro keys or LCD screens; it's as bare as it looks.

The Majestouch's only selling point is the fact that it uses mechanical switches, which are touted as being better for touch-typing, providing a more responsive feel. There's also evidence that they provide quicker input for gaming but you'll see less of an improvement than if you went from a generic mouse to one with a 1,000Hz USB polling rate.

The downside to mechanical switches is that they are incredibly noisy compared with membrane models. In fact, mechanical switches are so noisy that several members of the our team have received death threats from nearby colleagues in attempts to quell the incessant 'clickety click'. Noise aside, though, the Majestouch still feels good to use and the keys are very responsive. However, after prolonged use, the joints in our hand were beginning to show signs of shock, such was the hammering dished out by the mechanical keys.

We found there was a small difference in games, with movement to the left and right feeling snappier, but nothing to make it particularly worthy of your hard-earned cash. As for build quality, while the Filco could probably withstand a direct hit from the bullet of a 50cal sniper rifle, and the mechanical switches inside are similarly hardwearing, we can't help but feel that with the lack of features, you'd still consider yourself short-changed given the bloated price.

Overall
Nice to use, but too loud and too spendy.
58%

KITLOG

These are our four basic systems, with something for every taste. On this page, **The Game Box** is put together with money-saving in mind, but also an eye to getting as much bang for buck. It's the best value system for those who want a lot of processing grunt, but who don't want to sacrifice the upgradeability or compatibility that is so important. Intel's going to keep the P55 socket around for quite some time, so making the leap to this new platform is well-timed.

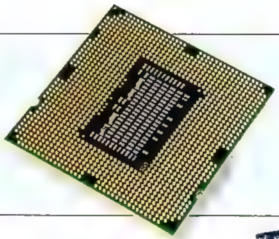
If you're going to spend money on a beast that generates pixels, you might as well spend a little more and get a screen that shows those pixels in their best light. This screen is that beast, and the 24 inches of colour-accurate screen boast a response time that will give you each sultry frame just as the game designer or movie director intended. Definitely a toy worth saving up for.

The Perfect PC, on the other hand, is the system everyone aspires to, with nothing but the best parts – without going crazy, though. It's a collection of all the greatest hardware that we'd pick without a budget, sure to impress with performance and sheer style.

Oh, and if you're wondering what the Ref IDs are, that's the ID of that article on our website. Just enter it like this – **www.atomicmpc.com.au/?NUMBER** – and you'll go straight to that review.

THE GAME BOX

CPU



Intel Core i5 760

PRICE $245

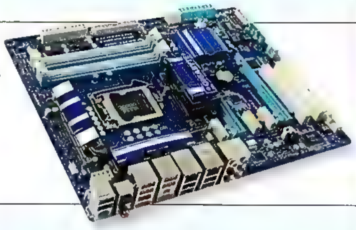
Intel's budget quad is more than you'll need in a chip – now even faster!

MOTHERBOARD

GIGABYTE P55A-UD4

PRICE $225

A great value P55 board with some nice features.



MEMORY

G.Skill Ripjaws F3-10666CL7D-4GBRH

PRICE $130

Great value, tight timings, and some flexibility.

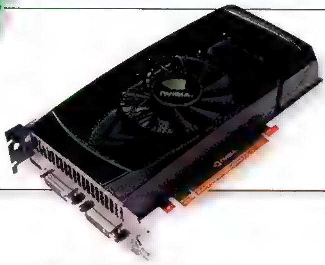
VIDEO CARD

NVIDIA GTX460

PRICE $245

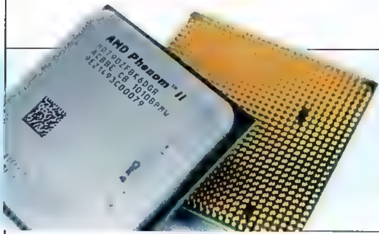
A reference-design card, but plenty fast for gaming bliss.

Issue 116, Page 38



THE PERFECT PC

CPU



AMD Phenom II X6 1090T

PRICE $355

Six cores of high-powered processing joy.

Red ID: 220395

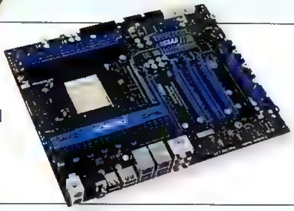
MOTHERBOARD

MSI 890FXA-GD70

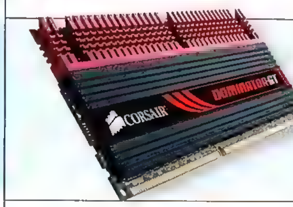
PRICE $265

A high-end AMD platform with full CrossFire support, great OC'er.

Ref ID: 221656



MEMORY



Corsair Dominator GT CMT4GX3M2A2000C8

PRICE $220

Red-hot memory for dual-channel speed.

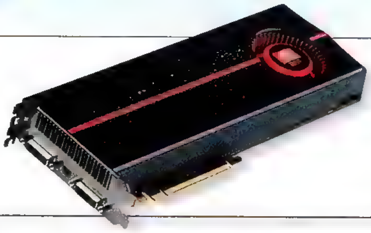
VIDEO CARD

ATI 5970

PRICE $780

A dual-cored DX11 beast, the most powerful yet.

Ref ID: 173167



For more builds check out the Kitlog E-mag at **atomicmpc.com.au/kitlog**

SUBTOTAL: $1660

COOLER

Coolermaster Hyper 212
PRICE $45

Nice cooling for a very affordable price.

CASE

Lancool Dragonlord PC-K62
PRICE $165

Vibration dampened, great cooling and sexy looks.
Ref ID: 160151

SYSTEM DRIVE

1TB HDD
PRICE $90

A thousand gigabyte storage drive on the cheap.

KEYBOARD

Razer Arctosa
PRICE $50

A cool-looking keyboard that'll serve you very well.
Ref ID: 149483

DISPLAY

Viewsonic VX2233WM
PRICE $215

21.5 inches of value-packed screen, great buy.
Issue 108, Page 42

MOUSE

Verbatim Rapier V1
PRICE $65

Great gaming performance and nifty features.
Issue 96, Page 43

AUDIO

Plantronics Gamecom 777
PRICE $80

Solid set of cans with great audio.
Issue 101, Page 41

Onboard Realtek ALC889A

A decent chip that does the job.

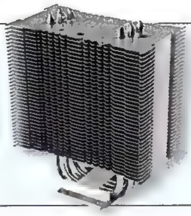
POWER SUPPLY

OCZ ModXStream Pro 600W
PRICE $105

Plenty of wattage, reliable, modular for neatness.
Issue 109, Page 59

SUBTOTAL: $4739

COOLER



Noctua NH-U12P SE2
PRICE $95

Two fans, quiet and nice overclocking capacity.
Issue 107, Page 48

CASE

Coolermaster ATCS 840
PRICE $370

Heaps of fans, plenty of space, and dripping with quality.
Ref ID: 132479

SYSTEM DRIVES

OCZ Vertex 2 100GB & WD 600GB VelociRaptor
PRICE $470 + $400

Superfast SSD with zippy storage.
OCZ Ref ID: 219218
WD Ref ID: 220323

KEYBOARD

Microsoft Sidewinder X6
PRICE $95

Backlit, sturdy, magnetic numpad & macro keys; what's not to like?
Ref ID: 129535

DISPLAY

Dell U2410
PRICE $699

In-Plane Switching, 1.07 billion colours and 24 inches.

MOUSE

Microsoft Sidewinder X8 Wireless
PRICE $105

Cable-less, comfortable, lag-free and fraggable!
Ref ID: 148422

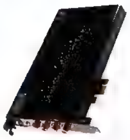
AUDIO

Logitech Z-5500D
PRICE $400

Earth-shakingly good.
Ref ID: 22626

Creative X-Fi Titanium HD
PRICE $270

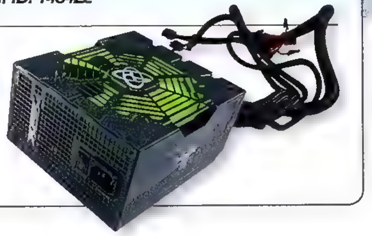
Seriously serious sound.
Issue 115, Page 47



POWER SUPPLY

XFX 850W
PRICE $215

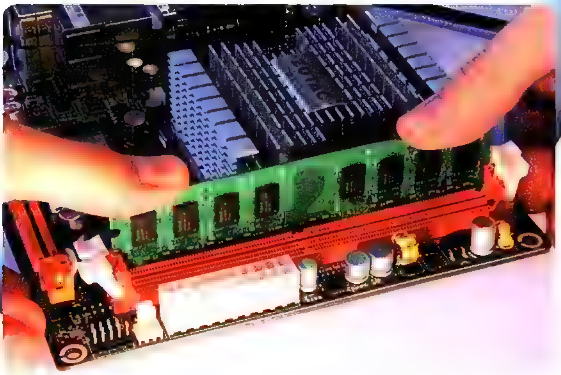
Plenty of power, ultra-stable rails and a great price.
Issue 107, Page 50



The **LAN Rig**, the ultimate in portable gaming power – go anywhere, frag anyone. No longer will you be tied to a desk or forced to awkwardly manhandle your full-sized rig, helped by a convenient handle and beefy tech. Perfect for wowing people at LANs, the tech inside is fast enough to run any game, and boasts enough speed to keep your game running at full clip even if other programs intrude in the background. After all, no-one wants to miss a headshot.

There are many benefits to running an ITX system, aside from the challenge of choosing compatible components, but here are just a few of the plusses:

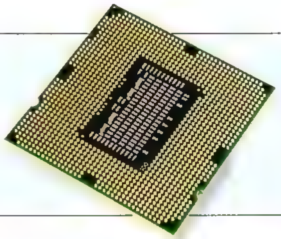
- Small footprint, so it'll fit damn near anywhere – even under a monitor.
- Lower power consumption due to restrained component choice.
- Generally low-noise due to the 'wind tunnel' design of most cases.
- Easily moveable around the house, or even taken to a mate's place – all you need is power and a screen.



Finally, for the more entertainment-minded – and really, that's all of us – there's **The Mini**, ready to play movies and music quietly and efficiently. The basic guts are fast enough for general tasks, and the IGP can handle High-Definition content. You can also choose from three entirely optional upgrades to suit your needs best: a graphics card for WoW, TV tuner to catch the game, or a Wireless card to sync without cables. The perfect energy-conscious build.

THE LAN RIG

CPU



Intel Core i5 760

PRICE $245

Intel's budget quad is more than you'll need in a chip!

Issue 106, Page 36

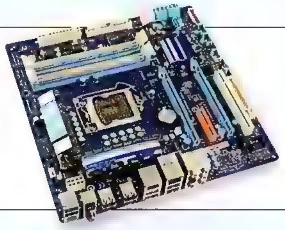
MOTHERBOARD

GIGABYTE P55M-UD4

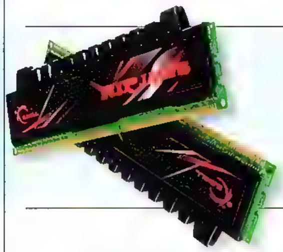
PRICE $200

Great overclockability, nice value.

Issue 107, Page 40



MEMORY



G.Skill Ripjaws 2000MHz

PRICE $190

Great value memory with amazing overclocking.

Issue 106, Page 52

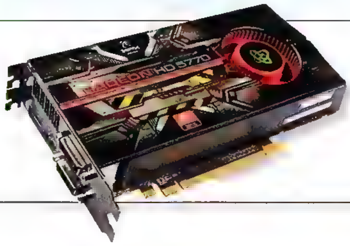
VIDEO CARD

ATI 5770

PRICE $190

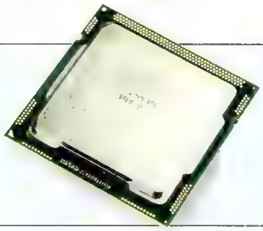
A decent value way to get into DX11.

Ref ID: 169775



THE MINI

CPU



Intel Core i3 530

PRICE $140

Speedy dual-core with an IGP for HD video duties.

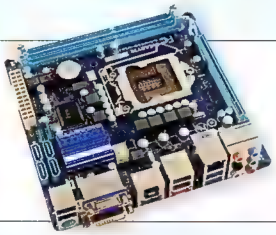
MOTHERBOARD

GIGABYTE H55N-USB3

PRICE $145

Tiny ITX form factor with up to 4 storage devices. Neat.

Issue 113, Page 39



MEMORY

G.Skill Ripjaws F3-10666CL7D-4GBRH

PRICE $130

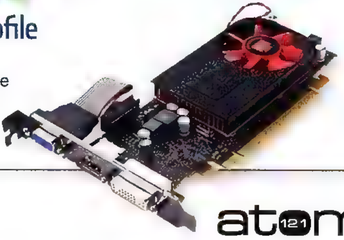
4GB of fast memory is plenty for running multiple HTPC media streaming apps.

VIDEO CARD

ATI 5570 Low Profile

PRICE $100

Graphical grunt in half the space. Enough for basic games, given the size.



For more builds check out the Kitlog E-mag at **atomicmpc.com.au/kitlog**

SUBTOTAL: $1655

COOLER

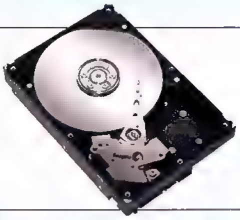
Intel Stock Cooler
PRICE FREE
Does the job, fits under PSU well.

CASE

Silverstone SG04
PRICE $160
Small case with handle; add two 120mm fans for awesome cooling.
Ref ID: 148266

SYSTEM DRIVE

1TB HDD
PRICE $90
A thousand gigabyte storage drive on the cheap.



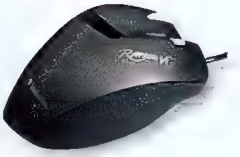
KEYBOARD

Razer Arctosa
PRICE $50
A cool-looking keyboard that'll serve you very well.
Ref ID: 149483

DISPLAY

Viewsonic VX2233WM
PRICE $215
21.5 inches of value-packed screen, great buy.
Issue 108, Page 42

MOUSE



Verbatim Rapier V1
PRICE $65
Great gaming performance and nifty features.
Issue 96, Page 43

AUDIO

Plantronics Gamecom 777
PRICE $80
Solid set of cans with great audio.
Issue 101, Page 41

Onboard Realtek ALC889A
A decent chip that does the job.

POWER SUPPLY

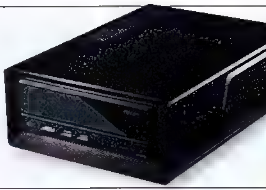
Corsair HX-520
PRICE $140
Modular, efficient and keeps size manageable in cramped case.

SUBTOTAL: $1033

COOLER

Scythe Big Shuriken
PRICE $55
Tiny 58mm height, quieter than a sponge.

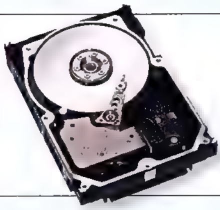
CASE



Antec ISK 300-150
PRICE $110
Included 150W PSU, good build quality, and decent airflow.

SYSTEM DRIVE

WD Scorpio Blue 640GB
PRICE $120
Fast 2.5" internal storage – grab two for more space!



COOLING

Noctua NF-R8
PRICE $22 x 2
Get some quiet, positive flow in this mini build.

OPTICAL

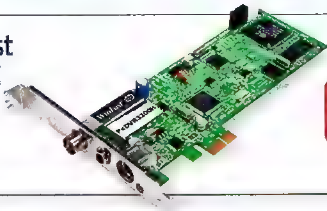
Lite-On DS-8A4S
PRICE $70
Slim internal DVD drive for movies, installs or backups.

KEYBOARD

Logitech diNovo Edge
PRICE $199
Wireless board with a trackpad for mousing.

TV TUNER

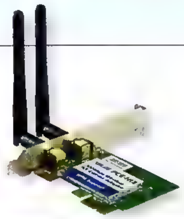
Leadtek Winfast PxDVR3200 H
PRICE $100
Get TV in your PC. H.264 recording ftw!



OR

WIRELESS

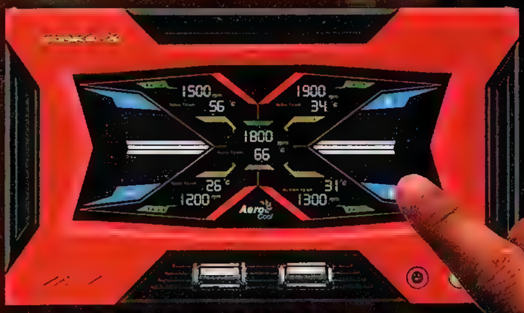
ASUS PCE-N13
PRICE $45
Zippy 802.11N for wireless HD video streaming.



AeroCool

STRIKE-X CASE

STRIKE-X FAN CONTROLLER



With "Touch" LCD technology

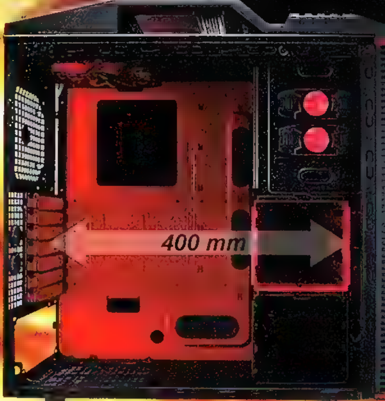
STRIKE X

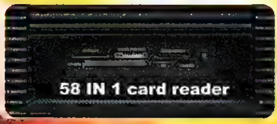
Cool Style Function Gaming Toughness

Are You Game Enough?

PGS R

Rs-4





1) SD /SDXC / EXTREME SD / EXTREME III SD / ULTRA SD / ULTRA II SD / ULTRA II SD PLUS / SD-ULTRA-X / ULTRA SPEED SD / SD PRO / SDHC /SD ELITE PRO / HS SD / MMC / MMC 4.0 / HS MMC / MMC 4.2/HS RS MMC / RS MMC / RS MMC 4.0 / MMC Mobile / MMC Plus (adapter required : MINI SD / HS MINI SD)
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www.xpmicro.com.au
www.itsdirect.com.au
www.stormcomputers.com.au

15
16
+55 XP
AH, EXCUSE ME MR HOLLINGWORTH, THERE IS A SPELLING ERROR ON PG...

One-note NPCs

Dan Rutter muses on the nature of repetitive game dialogue.

Any game that contains NPCs who talk to you will also contain NPCs who say the same thing over and over. And over.

Some NPCs won't even wait for you to talk to them before they spout their sole line, like an extra who's been driven to insanity by the joy of their very first speaking part.

Often the same damn line is shared by multiple different NPCs. See, for a recent example, the countless male, female, human and Ghoul NCR troopers in New Vegas who all wish to inform you that patrolling the Mojave almost makes you wish for a nuclear winter.

There's a boring and prosaic reason for this.

> Some NPCs won't even wait for you to talk to them before they spout their sole line...

But first let's explore the obvious alternative:

Give NPCs a variety of things to say. Have them pick one randomly when their talk button is pressed. Simple, right?

Nope.

Let's suppose you're a game-maker and you've made the effort to give a particular NPC *one hundred* things they can say, and they randomly pick from that list.

When they speak again, there is therefore only a 1/100 chance they'll say the same thing they said before.

When they say their third line, though, then if the previous two lines didn't match, there's a 2/100 chance that this new one will match one of them.

Calculating the probability that one or more matches *won't* happen, you get 1 for the first statement, 0.99 for the second, 0.98 for the third, 0.88 for the twelfth, and so on. To get the aggregate probability that a match won't happen after X choices, you multiply the probabilities leading up to X. For the fourth statement, that's 1*0.99*0.98*0.97*0.96, a little more than 90%. But by the time you get to statement 12, the no-match probability is down to 0.44. At statement 13 it's a mere 0.39, and it gets rapidly worse from there..

So even with a hundred possible things to say, randomly picking from the list makes it more likely than not that a statement will be repeated only ten or so statements later.

This problem also affects random-play algorithms for music. A true random-play is likely to replay tracks, or at least artists, far more frequently than listeners prefer.

The simplest way to avoid this, and also to cure the repetitive-NPC problem, is how 'shuffle'-play works: Prohibit a selection from being repeated until every other selection has already been made.

So our hundred-lined NPC randomly says something, and then randomly chooses another thing to say from the remaining 99 lines, et cetera.

So why do we still get so many one-note NPCs?

Well, here's that boring and prosaic reason. When you're making a game to a deadline, 'NPC dialogue variety' often has about the same priority as 'door of cupboard id #f3220a lacks squeaking sound'. But dialogue is a lot harder to fix.

There's not even much to be gained. Even when there's a lot of dialogue and proper scripted conversations, the player can end up just as annoyed when, inevitably, the well of unused lines runs dry. Every dialogue tree has to end somewhere, after all – look at *Poker Night at the Inventory*, which is twenty minutes of funny talking trying to distract you from a seriously defective Texas-hold-'em machine.

In days of yore, spoken game dialogue was impossible, and game designers could put huge amounts of text-only 'talking' in a game that came on four floppies. But even *those* games have repeating dialogue in them, and many of them even have one-line NPCs.

The main reason for this was that repeating dialogue is actually a *positive* feature - it informs the player that You Need Speak No Longer To This Dude.

It's still a rather large immersion-breaker, though. Clearly, all those lazy game-writers need do is create sentient NPCs with greater intelligence than most players.

This always seemed to work out very well in *Star Trek*, after all.

Dan has at *least* 200 lines of dialogue.
dan@atomicmpc.com.au

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There's something very Atomic about being on the bleeding edge. About building a beast with more processing power than you will possibly ever need with more graphics cards than you can poke a stick at. For ten years we've been showing you how to build the best and the fastest and the biggest (or the smallest, if you prefer).

But sometimes all you need is good enough. Sometimes it's just about getting that box that's been ageing gracefully in the corner to a point where it'll get you through the next round of games. For those times: there's this months tutorial.

Also, Chris Taylor takes you by the hand down the hallowed halls of tertiary education – find out what to expect and what's expected of you at TAFE and Univeristy. If you've just finished Year 12 and are planning to keep studying, you'll be fascinated.

Learn on, kids!

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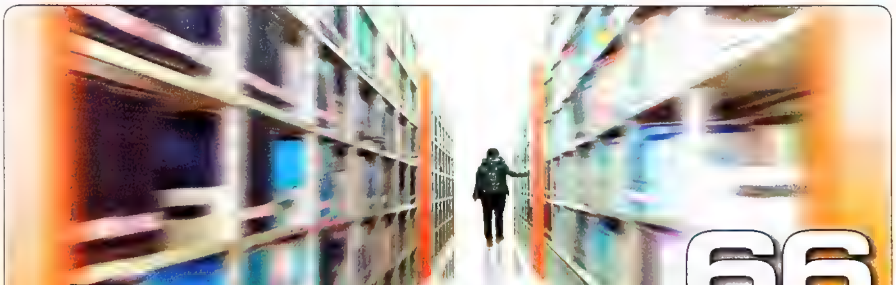
We show you how to bring your WinXP box into the 21st Century.



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Issue 3, March 2010
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The transition to tertiary

Chris Taylor on how to adjust to life as a little fish in a very, very big pond.

By the time you read this, the TAFE and university semesters will be about to begin. Whether you're returning to study after several years in the workforce, or heading straight into your tertiary education after completing secondary school in 2010, you're probably a little daunted by what's about to happen. University and TAFE offer completely different experiences to each other but both are far removed from the compulsory schooling experience.

It's easy to cruise through school if you complete the assigned work. Even through the final years of schooling, teachers effectively hold your hand, reminding you when to hand in work or closely monitoring what you're doing with your time in class. They tell you when and where the exams are. To a far lesser extent, TAFE offers the same 'safety net'. Someone is watching over you, ensuring you do what you're supposed to do to at least pass their subject.

University, however, is very different, even in the first year. Few of your lecturers will even know your name, let alone your problems or the unique circumstances that may make your life difficult. They probably won't care about that stuff, either. Even if they do, they're governed by many regulations that preclude them from being too flexible or understanding. There are few reminders about when to hand in work. There's often little or no time to complete assignment work in class. No one cares if you're using your time in class unproductively, just as long as you're not disturbing others. No one will warn you to pull your socks up if you slack off and only attend tutorials sporadically: you'll just fail the subject because of your lack of attendance. Both TAFE and university, but especially the latter, require you to demonstrate initiative.

Studying

How classes are organised at TAFE and university bears some similarity, but many differences, to how they are run at school. Each semester you'll have to enrol in some core subjects, but often there will be room for some electives. You can generally choose subjects from faculties other than your own. So, for example, you could do a Bachelor of IT, majoring in programming but minoring in marketing or business law. It's easy to see the massive range of subjects available and to choose your first few carelessly, but it's worth putting thought into it. You'll only have a limited number of electives over the course to play with. If you're determined to major or minor in something, make sure you understand what subjects you need to undertake. Be aware that you can't enrol in just any subject: a lot of them require you to have completed something else first or to be in another class concurrently.

How your time is spent in class is very different to school. Most subjects are divided up into lectures and tutorials, the latter of which put into practice the theory delivered in the lectures and/or weekly readings (although sometimes they offer something far removed from both) and offer an experience that's probably as close as it gets to still being in school. You're in a fairly small group and the tutor will (hopefully) know your name. They'll be your first point of contact if you have any problems with the subject. Some subjects and faculties offer different arrangements, though. You may have workshops and seminars, which are sort of a cross between tutorials and lectures. You may have practical sessions in a laboratory if you're studying a science. Whatever the case, you're generally expected to attend class at least 80 per cent of the time. Attendance is recorded in seminars and tutorials. As part of university and TAFE policy, lecturers and tutors have to be able to tell their superiors that you were usually in class – otherwise, no matter what your marks in assignments and exams may be, they can't really claim you understand as much of the subject matter as you're supposed to. If you reckon you can't make the 80 per cent attendance rate, speak to your lecturer or tutor in advance. Sometimes they just can't help you, but they'll usually try and work out some arrangement: make-up tasks, tutorials at an alternative time or campus or whatever. It's up to you to take the initative and deal with the situation before it becomes a problem.

Indeed, that's the best approach with all difficulties you face academically. If you're having difficulty with any aspect of the subject – vague assignment briefs, a misconception about some part of the subject matter, difficulties handing work in on time for whatever reason – it's best to deal with it early. Speak to your tutor and lecturer in that order. If you're dissatisfied with the response, go higher and speak to whoever co-ordinates the subject or deals with academic grievances in the faculty. Many universities offer classes in writing essays and delivering oral presentations, if they're things you find difficult.

Generally, universities will go out of their way to help you if you approach them before everything comes crashing down around you. Failing a subject in university is not something you want to experience. Depending on what it was, you may have to repeat it or even appear before a panel of university staff to explain yourself and justify your right to breathe the university's fine air. It's an expensive exercise, as each class you undertake – even repeats – adds to your HECS-HELP debt.

While the time you have to spend on-campus at university and with many TAFE courses is far less than what you would've had to at school, you shouldn't slack off or get too caught up in extracurricular commitments. There's no one to remind you to stay on task. It's up to you to ensure you read whatever the assigned material is on time. It's up to you to keep abreast of changes to assignment briefs. It's up to you to hand work in on time, in the correct place and in the correct fashion.

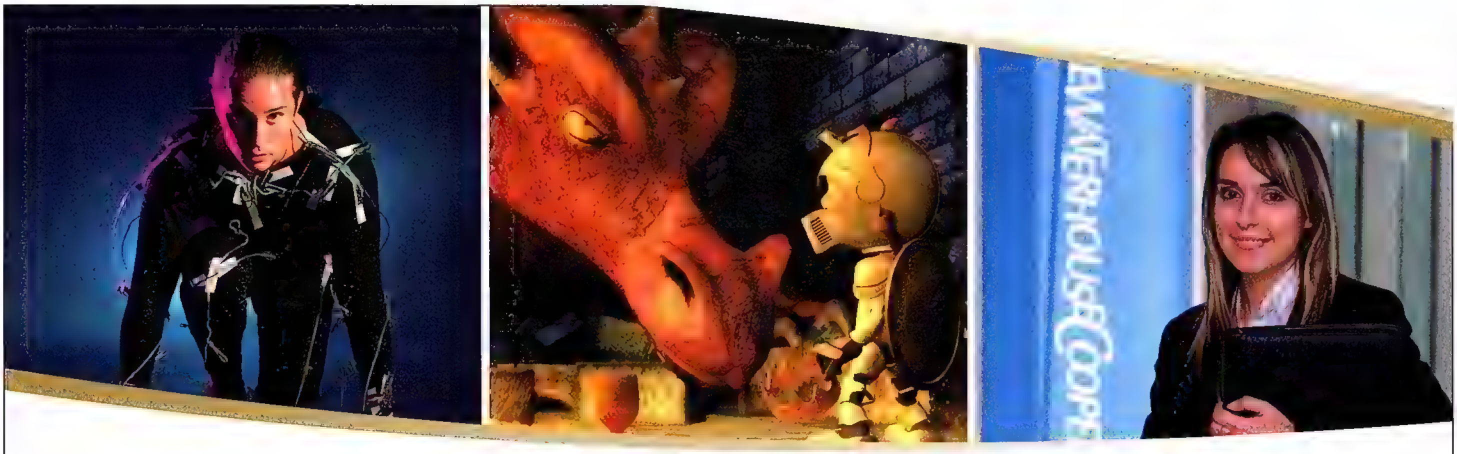
Getting around campus

Those first few weeks are going to be somewhat overwhelming. If you're at a very large campus, it'll be easy to get lost. University websites are notoriously poor sources of useful information. Neither of the two universities I attended bothered to provide visitors to the websites with usable maps. Usually, if you join the student union or at least give them a little bit of money, you'll be provided with a diary that contains a small, fold-out map. Endlessly valuable in those early days or when some faculty scheduling conflict sees you standing outside a lecture theatre, looking at a sign that tells you to go to some room you've never heard of in a building you've never heard of.

Aside from the diary, find the student services desk for your faculty and check out what they offer. It's the job of the staff there to help you find places and deal with administrative issues. Visiting them in person or at least emailing them is always more productive than trying to sift through all the crap on a university's website for information that's valuable and relevant.

The union people can help you too, although it's up to you whether you join them. If you're going to regularly take advantage of clubs and societies and the social events they put on, it's worthwhile. The various events and clubs organised by the union can be a great way to meet new people. If your classes are spread across a couple of campuses of the university, the union may fund some kind of shuttle bus service. If you need to take this several times a week, the cost of union membership will soon pay for itself. Otherwise the value is debatable. Sure, they provide advocacy and support if you get into some sort of difficulty with the faculty, but you usually won't have that much trouble getting that help even without a membership: you might have to pay for it, but nothing on campus is ever that expensive. They usually provide some sort of additional discount at the university bookshop but, unless you have to buy expensive books for eight subjects each year , the total discount may not exceed the union's annual membership fee. Even if it does, you may find books more available for an even lower price through online retailers such as Amazon and The Book Depository. Union people will often be present at orientation events, seeking your money. Your best bet for seeing if the union offers anything that's valuable to you is to look at their website.

Large university and TAFE campuses often have shops, banks and a variety of food purveyors. Honestly, over the years I spent at university I found most of the stuff sold on campus to be of poor quality and overpriced, even though it was pitched at students (although campus bars always have cheap beer), largely because these places figure they've got you over a barrel. Most universities are situated near shops or eateries. Wander around during your break and see what's available nearby: it may be better and cheaper.



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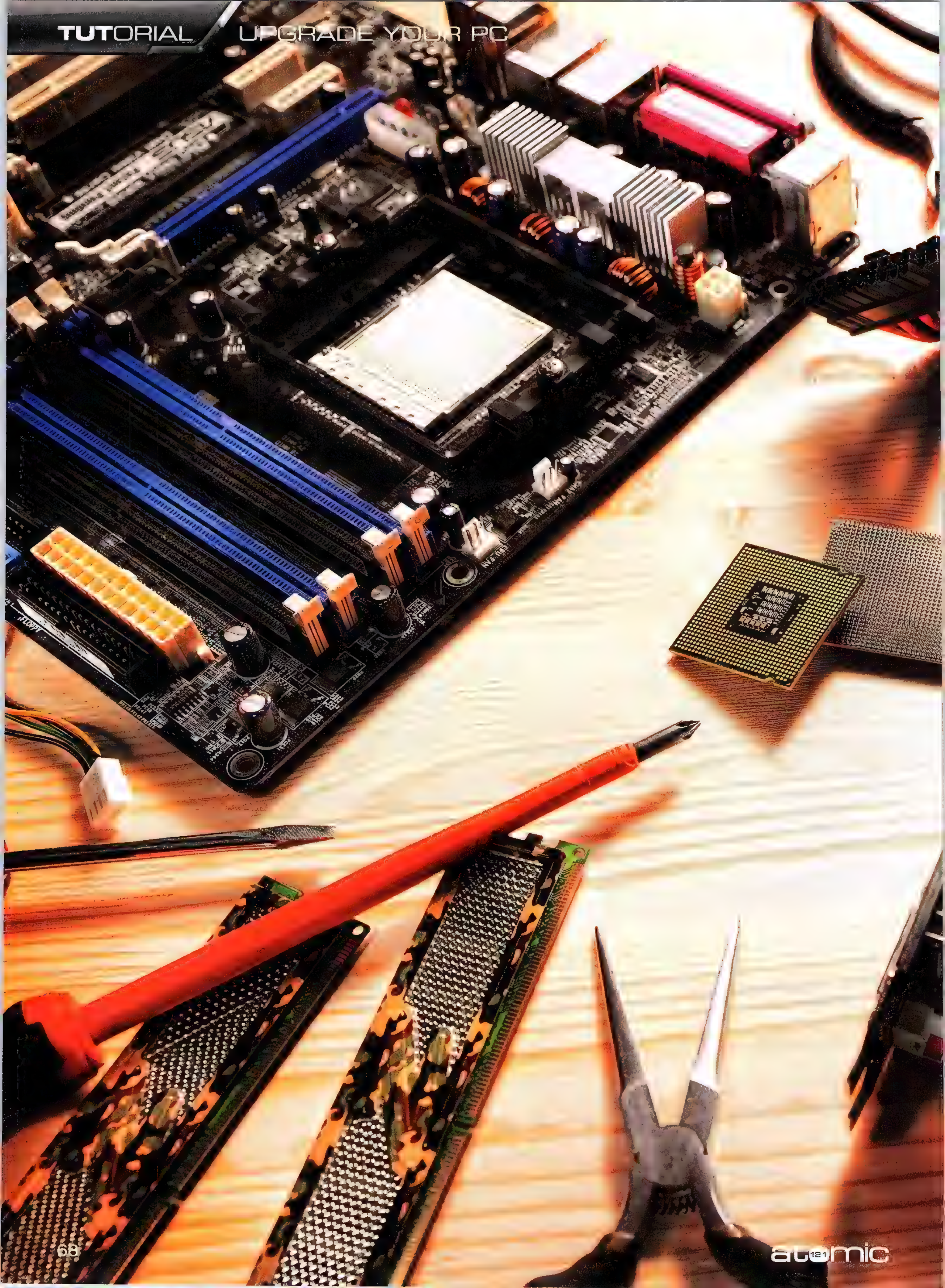

UPGRADE YOUR PC

2010 was a great year for PC gamers, with a plethora of highly enjoyable games to experience. However, what happens when you have an old PC that struggles to even play the games of 2009?

We've all been there – you rip the cellophane off the DVD box or wake up early to buy a new game on Steam only to find that the game is more jerky than a one-legged man trying to ride a unicycle over an army assault course. Welcome to the dark side of PC gaming - the universal law that states that at some point, your PC will become too old to run the latest games to your satisfaction.

Don't give up on PC gaming just yet, though, and switch to an evil, dumbed-down console. Take heart from our feature, which shows you a selection of cost-effective upgrades to bring your ailing PC up to date. There's no need to panic if you've never opened up your PC either, as this feature shows you the easiest and cheapest ways to enjoy the best games of 2010 on an aging PC.

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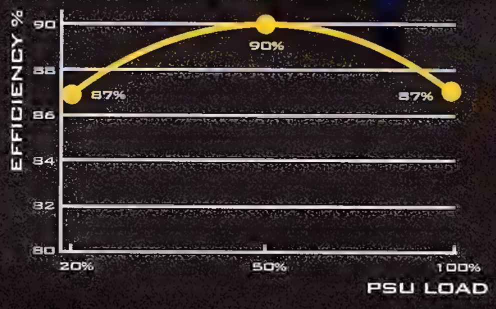
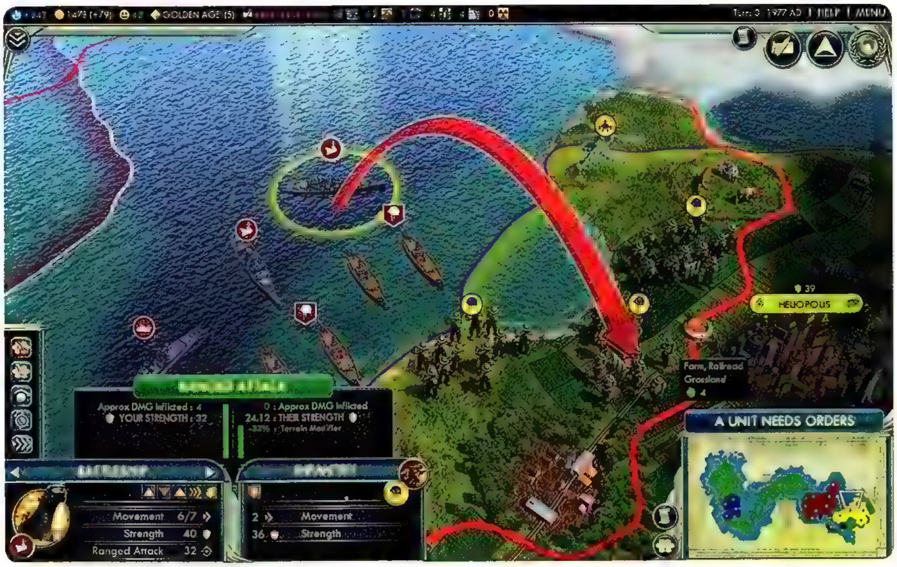


www.silverstonetek.com

The GAMES

Despite what some pundits are saying, PC gaming is very much alive and well, as evidenced by this list of great games that were released this year. These are the games that we played on our aging PC.



Arma II: Operation Arrowhead

www.arma2.com

Operation Arrowhead is a standalone expansion to Arma II that doesn't fundamentally change the gameplay. It's therefore still a very unforgiving military sim. If you're expecting to run, gun and live then forget it – in this game, you have to think like a soldier to survive. Operation Arrowhead delivers more than 300 new units, buildings and weapons, plus several key improvements, such as a much more realistic thermal imaging engine. If you want a break from the mass of mindless shooters, Operation Arrowhead is a welcome change of pace.

Battlefield: Bad Company 2

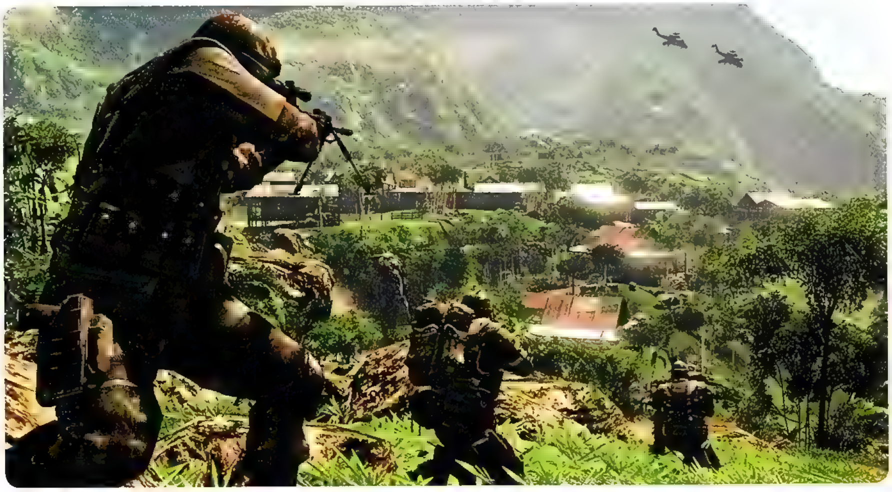
www.battlefieldbadcompany2.com

It's fair to say that Bad Company 2 is, at last, a return to form for the Battlefield series on the PC. The multiplayer is present and correct, with the appropriate server browser options also present and accounted for. The graphics, sound effects and art style bring back fond memories of Battlefield 2, but have been significantly improved. What really makes Bad Company 2 special, though, is the Frostbite physics engine, which means that every object in the game can be destroyed. This adds a whole new element to multiplayer games, as you can no longer rely on hiding behind cover. All the elements of Battlefield 2 that fans could possibly want are there, though the singleplayer game is a touch short and undercooked.

Civilization V

www.civilization5.com

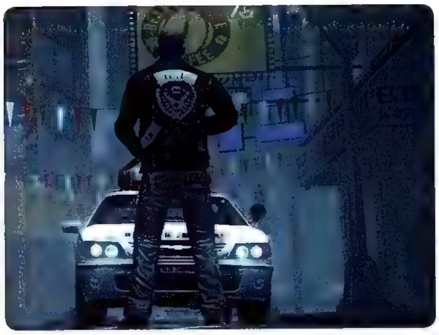
If you aren't familiar with the premise of Civilization V then it's a turn-based strategy game that involves taking a civilisation from the dawn of time right up to the post-modern era, with big stompy robots gouging out chunks from the landscape with lasers. Beware, though, Civilization V is more addictive than most narcotics, with individual games easily taking up hundreds of hours. Civilization V is a storming classic strategy game that will eat up your social life. Say goodbye to your friends and family – it's time to seal yourself off from society once again.

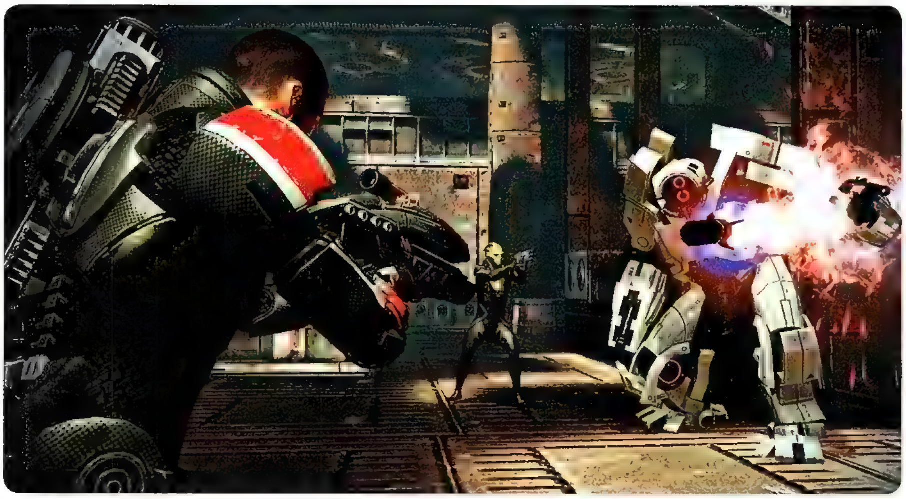


Fallout: New Vegas

http://fallout.bethsoft.com

Although the engine used to create New Vegas – the same one used by Oblivion way back in 2006 – is now very long in the tooth, there are still times when New Vegas' wit and charm shine through like a beacon, making it clear that the Fallout universe is about more than just





underground vaults and super-mutants. Sporting a new Hardcore difficulty mode that brings this standalone expansion to Fallout 3 closer to the original Fallout games in terms of tone, New Vegas feels like a return to form.

GTA IV: Episodes from Liberty City

www.gta4.net

Although Episodes from Liberty City uses a fairly old engine, it still looks amazing and more importantly, the core gameplay is good. The missions range from low-key brawls to crazy acts of urban warfare, and the experience between the two episodes is varied enough that it's almost like playing two different games. Each episode is smaller than the original GTA IV, but you still get a lot of game for not a lot of money.

Just Cause 2

www.justcause.com

Just Cause may have less plot than a blank piece of paper and be as mindless as Michael Bay's zombie corpse, but there's an interesting philosophical question that crops up in our minds whenever we pause to consider it. Namely, how directed should players of sandbox games be? In this case, Just Cause 2 very much leaves the player to decide what to blow up in as spectacular manner as you can imagine. As a result, Just Cause 2 is a lot of fun; just don't expect the narrative to become more complex than Pong!

Mass Effect 2

http://masseffect.bioware.com

It seems that BioWare's domination of the RPG genre knows no end, and there's no denying that Mass Effect 2 is one of the best RPGs of recent years. Probably one of the best ever made in fact. Carrying on almost immediately from the first game, you can even transfer your saved game if you like, meaning that decisions you made the first time round may come back to haunt you. While the combat is still the same arcade action and a little too simplistic for hardcore PC gamers, the story and dialogue are of such good quality that the occasional bout of unwieldy combat isn't a big problem. Not only does Mass Effect 2 improve on the original, but it's also whetted our appetites for Mass Effect 3 so that we can find how this awesome trilogy will conclude.

Napoleon: Total War

www.totalwar.com

Napoleon is a standalone expansion to the brilliant, but ultimately flawed Empire: Total War. It narrows the focus considerably, being set just in Europe rather than the entire world. As a result, Napoleon is definitely superior and deserves to in the game collection of every armchair general. It's smaller in scope, but compensates for this with increased detail and greater longevity through the multiplayer aspects. Napoleon's legacy has been treated with proper justice and will undoubtedly have you sitting bleary-eyed in front of your computer for many late nights.

StarCraft II: Wings of Liberty

http://eu.starcraft2.com

Flying in the face of 12 years of development in the RTS genre, there's no way that StarCraft II should be any good. Haven't we moved on from unit-churning mechanics, complex resource systems and base building? The reality, however, is that StarCraft II is brilliant. The core gameplay may not have moved on much, but it's been polished to perfection and Blizzard has outfitted the campaign with missions designed to hammer that home brilliantly. Some ideas fall rather flat, but the highlights shine brilliantly through.

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Meet the OLD PC

Space and time keep us from showing you how to upgrade every old box out there, but hopefully our example PC will give you a starting point. Let's take a look at what we're dealing with.

Our example PC is almost exactly four years old. It was one of the first to feature an Intel Core 2 Duo CPU, an incredibly important processor for Intel as it was the first CPU the company had produced in nearly five years that could take on AMD's hitherto massively successful range of Athlon-branded chips. The particular CPU in our example PC is the dual-core 2.4GHz E6600, which was one of the faster and more expensive processors in the first batch of Core 2 Duo chips.

The graphics card is the other most important component in a gaming PC, so the Nvidia GeForce 7950 GT XT card was of particular interest to us. This was one of the last cards in the DirectX 9-compatible GeForce 7-series, and when Nvidia launched it at a time when it had already started releasing its DirectX 10-compatible GeForce 8-series cards. Still, the GeForce 7950 GT XT has 512MB of on-board memory, the same as many modern graphics cards, and has the added benefit of being passively cooled, so it's silent. Before doing anything else, we updated its drivers to the latest version.

Our old PC also includes 2GB of PC2-8500 DDR2 RAM sitting in an EVGA motherboard based on the Nvidia nForce 680i SLI chipset. This chipset became notorious for killing RAM and USB memory sticks, but when it first launched it was the only chipset that supported SLI - Nvidia's proprietary technology that combines the processing power of two graphics cards to speed up games. Like most PCs of its age, our example system runs Windows XP.

How fast is a four-year-old PC?

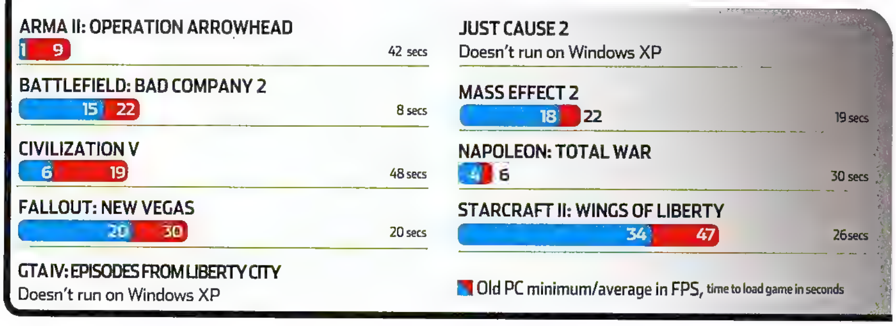
Given the age of our example PC, we thought it unlikely that anyone who owned such a system would have upgraded the monitor. Therefore we decided to try playing our nine great games at 1,280 x 1,024, the native resolution of most PC monitors four years ago.

Where possible, we tested each game using the 'high' quality preset in the graphics options menu. We played each game through for a few minutes while recording the minimum and average fps. The minimum frame rate is particularly important, as any dip below 25fps will be immediately visible as a jerk or pause in the game, ruining your aim or sending you skidding off the track in a racing game.

As well as measuring the PC's minimum and average frame rate in each game, we also timed how long it took to load a level. This number (in seconds) may not seem particularly long in isolation, but when you're twiddling your thumbs as you sit in front of a blank monitor, it can seem like ages. What's more, a long load time in multiplayer games means you start each level at a significant disadvantage to gamers with faster PCs.

Unfortunately, as you can see in the graphs below, our old PC struggled to play nearly all the great games released this year. Arma II, Civilization V and Napoleon: Total War, for example, had minimum frame rates below 10fps, which made playing them about as pleasant as drinking a pint of habanero chilli extract. Several other games, such as Bad Company 2 and Mass Effect 2, were at least nearly playable, with minimum frame rates close to 20fps. However, even after we'd updated the drivers to the latest version, the games (and several others) couldn't display textures properly. The corrupted texture effects varied from game to game, but in Mass Effect 2, for example, a rumpled cloth effect was also used on the arm and skin of characters, making them look like burn victims. Two games, GTA IV Episodes and Just Cause 2, refused even to load. In fact, only one game ran smoothly on our PC – StarCraft II. In summary, our four-year-old PC was as pleasant to play games on as eating a medium-rare whale steak.

Results



Upgrading the CPU

AMD and Intel change CPU sockets every few years, but if your PC is a similar age to our example system, chances are that you'll still be able to upgrade the CPU. We find out if upgrading to a more modern CPU makes games run substantially faster.

How to upgrade the CPU

The first thing to do when considering a CPU upgrade is to check the specification of your current CPU and motherboard. The free utility CPU-Z (**www.cpuid.com**) should be able to identify your CPU and can recognise many motherboards too. If CPU-Z can't help, you'll need to open up your PC and have a look – the name is usually printed between the PCI and PCI-E expansion slots. Once you know which motherboard you have inside your PC, you need to find out which CPUs it can support with the latest BIOS (a software update) from the manufacturer's website.

When we first dug out our example PC from the corner of the lab, its EVGA motherboard supported only dual-core and quad-core 65nm LGA775 Core 2-branded CPUs, which are no longer available. After browsing the EVGA website, however, we found that a BIOS update would enable us to install a dual-core 45nm Core 2 Duo E8000-series CPU, some of which are still available to buy. Flashing the motherboard's BIOS takes barely any time, and few minutes later we swapped out the original 2.4GHz Core 2 Duo E6600 for a 3GHz Core 2 Duo E8400 (around $195) and started benchmarking the PC again.

What difference does it make?

Given that the original CPU in our example PC was just over four years old, we were expecting to see a substantial difference in how quickly the PC ran games after we'd upgraded the CPU. We were sorely disappointed. The all-important minimum frame rate barely improved in Arma II, Civilization V, Bad Company 2, Mass Effect 2 and Napoleon, so all five games still ran far too slowly to be enjoyable.

The news isn't all bad though. Fallout: New Vegas improved considerably after the CPU upgrade, with the game's minimum frame rate leaping from a jerky 20fps to a smooth 27fps. The game also loaded significantly faster, with the average load time dropping from a lengthy 20 seconds to a much more reasonable seven seconds. Other games also loaded a fair bit quicker once we'd upgraded the CPU, which indicates that a faster CPU doesn't only benefit game frame rates but also shoves data through the system faster.

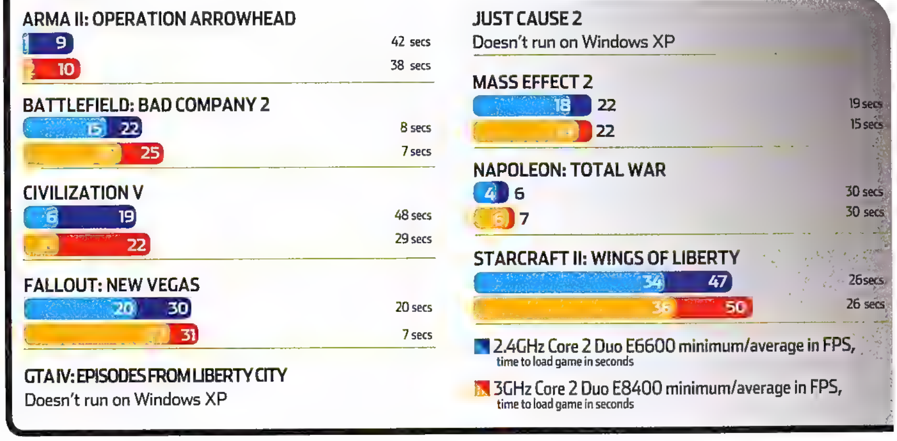
Conclusion

Upgrading the CPU in our four-year-old example PC made little appreciable difference to the frame rate in most of the games we tried, which meant they still ran too slowly to be playable. Frankly, if we'd just spent nearly $200 of our own money on the E8400, we would have been tempted to ask for a refund.

The problem is that unlike graphics cards, CPUs don't drop significantly in price as they get older. Even though the Core 2 Duo E8400 processor we used to upgrade our PC is already two years old, it still retails for a pricey $195. In contrast, you can pick up a far more capable and modern quad-core Core i5-760 CPU for just a few dollars more, although as it uses a different socket, it would also require a new motherboard and RAM.

Based on this experience, we advise that if your PC is less than four years old and has a Core 2 Duo or similar spec CPU, it's not worth replacing just yet. As you'll discover in the rest of this feature, there are several far more cost-effective upgrades you can make to your ageing PC.

Results



Upgrading the RAM

Most PCs of a similar age to our example PC will have just 2GB of RAM – less than half of what most PCs are armed with today. With this in mind, we set about doubling our ageing system's memory to a heftier 4GB.

System memory is very important to performance, as it's where your computer stores the data from all the applications that are running. If your system doesn't have enough memory, games and applications will take much longer to load and will pause randomly every few minutes as the PC writes data to the page file on the hard disk. In theory, adding more memory should allow our aging PC to run games much more satisfactorily.

How to upgrade the RAM

Four years ago the most common type of memory in both AMD and Intel-based systems was dual-channel DDR2 DIMMs (dual in-line memory modules). To work at its best, this type of memory should be installed in pairs (hence 'dual-channel'). However, although most motherboards have four DIMM slots, two of which should be free, we don't recommend installing 2GB of additional memory into these vacant slots. This is because it's important that the chips inside the DIMMs all have the same spec – if they don't match, your system may start crashing at random.

Therefore, if do you plan to upgrade the RAM in your PC, we recommend selling the existing RAM on eBay and buying 4GB of shiny new memory. Make sure you buy from a reputable manufacturer – the hassle you'll experience with unbranded or generic memory just isn't worth the few cents you'll save. Before you install the new memory, don't forget to check your motherboard manual to see which DIMM slots you should use to ensure that it runs in dual-channel mode. If you're not sure you've got it right, you can find out whether the DIMMs are installed correctly by looking in the memory tab in the free utility CPU-Z (**www.cpuid.com**).

How much differencedoes it make?

Armed with 4GB of PC2-8500 DDR2, which set us back around $80), we set out to re-test our example PC. Unfortunately, as with upgrading the CPU (see p75), we found that doubling the RAM in our ageing PC made no difference to the all-important minimum frame rate in most games. The only exceptions were Fallout: New Vegas, which leaped from a jerky 20fps to a smooth 27fps, and StarCraft II, which was already smooth and playable with 2GB of RAM.

On a more positive note, adding more memory reduced the load times of most games, with both Fallout: New Vegas and StarCraft II loading in almost half the time they took with 2GB of RAM.

That said, we'd rather have a system that takes a while to load games but plays them smoothly than the other way round.

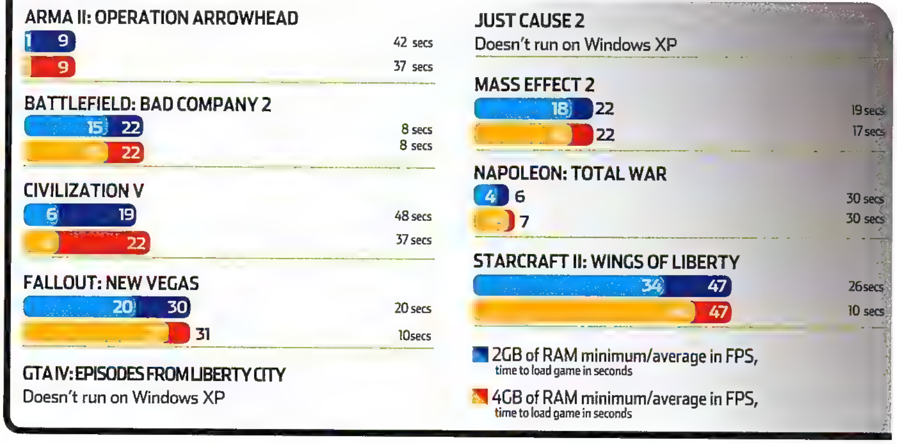
Conclusion

Given how much system memory modern PCs have, we expected to see more of a difference when we upgraded our ageing system's RAM. The results were very disappointing, with only one game seeing a useful frame-rate increase from the additional memory.

This is because while 64-bit CPUs and PCs with 4GB or more of system memory have been available for years, 32-bit operating systems have remained prevalent until very recently. This is a problem, because 32-bit operating systems such as Windows XP can't address more than 3.5GB of RAM, so some of the memory we bought wasn't even used. What's more, Windows XP can't allocate more than 2GB to any application, even if you have more RAM that this.

As a result, game developers have been slow to take advantage of the larger amounts of memory installed in modern PCs. We hope this will change soon, although it hasn't helped that Microsoft released a 32-bit version of Windows 7 along with the 64-bit version. In the meantime, our advice is that if your ageing PC already has 2GB of memory, it's not worth upgrading just yet. Read on to find out which upgrades are more cost effective.

Results



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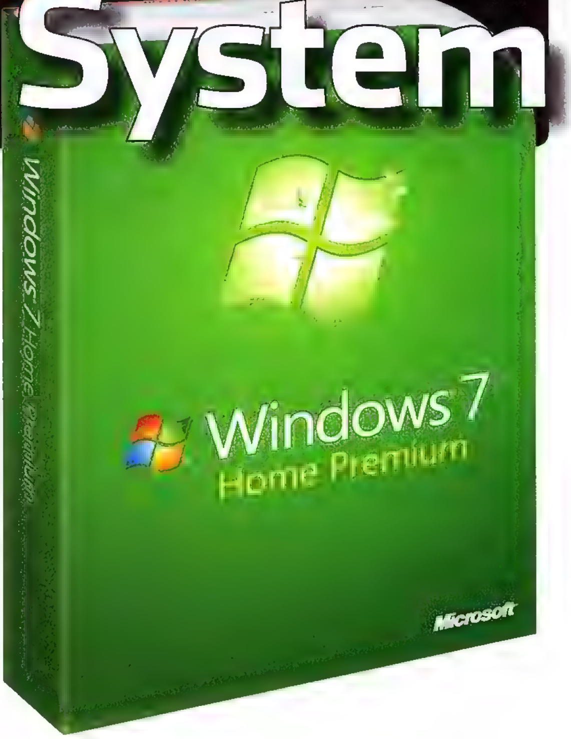


Most people think of upgrading as swapping old items of hardware for newer, faster versions. However, given how badly old hardware struggles with modern games, we find out if it's also worth upgrading our example PC's operating system.

It's hard to believe that four years ago the most widely used operating system, Windows XP, was already five years old. Since then, Microsoft has released Windows Vista, but the less said about that appalling operating system the better. Fortunately, in late 2009, Microsoft finally released a worthy successor to Windows XP - Windows 7 - although it made the criminal error of releasing both 32-bit and 64-bit versions.

Our recommended version of Windows 7 – 64-bit Home Premium – costs around $110, so isn't a particularly expensive upgrade, yet it offers a number of key benefits over Windows XP. The interface has received a complete facelift, so it's now better able to control multiple applications at once. Windows 7 is also a lot more stable than Windows XP and more secure against viruses and spyware, although you should still install third-party security applications. Most importantly for gamers, Windows 7 supports DirectX 10 and 11, which many new games require to run. In contrast, Windows XP supports only DirectX 9, which means it can't run games such as GTA IV and Just Cause 2.

How to upgrade the Operating System

Upgrading from Windows XP to Windows 7 is one of the easiest possible upgrades, as you don't need to open up your PC. That said, if your PC is more than four years old, there's a chance that some of the components may not be compatible with Windows 7, so make sure you run the free Windows 7 Upgrade Advisor utility, available at **http://tinyurl.com/win7upadvisor**, before you buy. Finally, if you install the 64-bit version of Windows 7 (and you really should), you'll need to format your hard disk. In other words, before you insert the Windows 7 DVD into your optical drive, make sure you back up all your personal files, such as photos, music and videos, to a different hard disk or external drive.

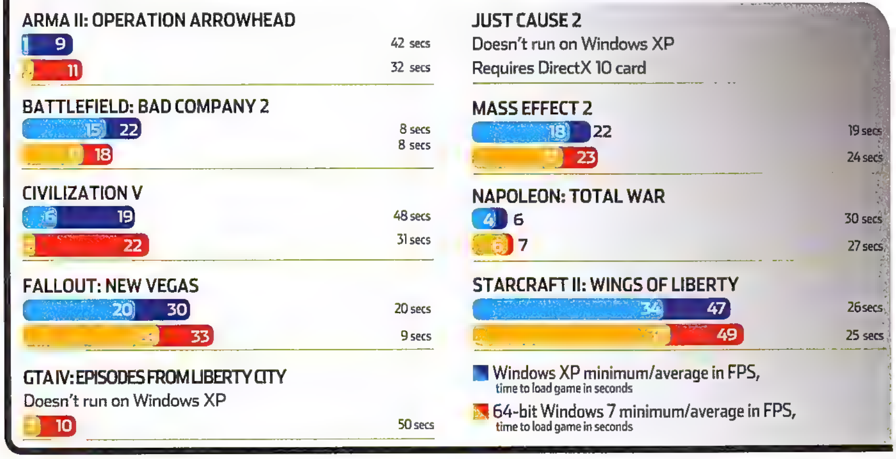
How much differencedoes it make?

Our old PC was a lot more responsive and pleasant to use once we'd replaced the geriatric operating system with Windows 7, but what we really wanted to find out was whether the upgrade benefited gamers. After all, it's generally accepted that you ought to have 4GB of RAM installed if you're going to use Windows 7.

The most immediate benefit was that, with the exception of Bad Company 2, which already loads very quickly, all our test games loaded faster on Windows 7 than on Windows XP. Clearly, Windows 7 has far better memory and I/O management than Windows XP.

Fallout: New Vegas, Napoleon and StarCraft II also had slightly faster frame rates on Windows 7, but Bad Company 2, Civilization V and Mass Effect 2 ran slightly slower. In short, Windows 7 won't necessarily make your games run faster than on Windows XP, but they won't run significantly slower either, even if your PC has only 2GB of RAM.

Results



Upgrading to Windows 7 also allows you to play games such as GTA IV, although it ran at such an abysmally low frame rate of 3fps with the original GeForce 7950 GT XT graphics card in our PC that it wasn't playable at all. Unfortunately, as the graphics card doesn't support DirectX 10, we were still unable to play Just Cause 2 on Windows 7, but at least Windows 7 opens the possibility of playing games like this that don't run on Windows XP.

Conclusion

We were pleasantly surprised to find that upgrading from Windows XP to Windows 7 made a significant improvement to how the system responded to our commands, including how quickly it loaded games. It actually had a greater effect on performance than sticking with Windows XP and doubling the amount of system memory. Given how much more intuitive and advanced Windows 7 is in other areas compared with its nine-year old predecessor, we think it well worth saving up for this substantial upgrade, especially as more and more games won't even run on Windows XP.

Upgrading the Graphics Card

Along with the CPU, the graphics card has the most important role in determining how quickly your PC plays games. We dug out three recent graphics cards from the treasure chest in our lab to see how much graphics technology has improved over the past four years.

The GeForce 7950 GT XT in our example PC was one of the last graphics cards to have discrete pixel and vertex shaders. In fact, a few months before this card was released, Nvidia had already debuted the world's first graphics card with multifunction stream processors, the GeForce 8800 GTX. This now legendary card started the stream processor revolution, passing the torch to the subsequent GeForce 9-series, 200-series and, most recently, the 400-series. This means that, on paper, the GeForce 7950 GT XT is four whole generations behind today's graphics cards.

As graphics cards are available in a range of sizes, shapes and prices we decided to try upgrading our ageing PC with three different cards. This way, you can see how much additional performance you can expect depending on how much you spend. The three cards are the $130 GeForce GTS 450, the $150 GeForce GTX 460 768MB and the $450 GeForce GTX 480. The latter card obviously costs a lot more than the two, but we wanted to see what effect installing the fastest graphics card in the world would have on a four-year-old PC.

How to upgrade the Graphics card

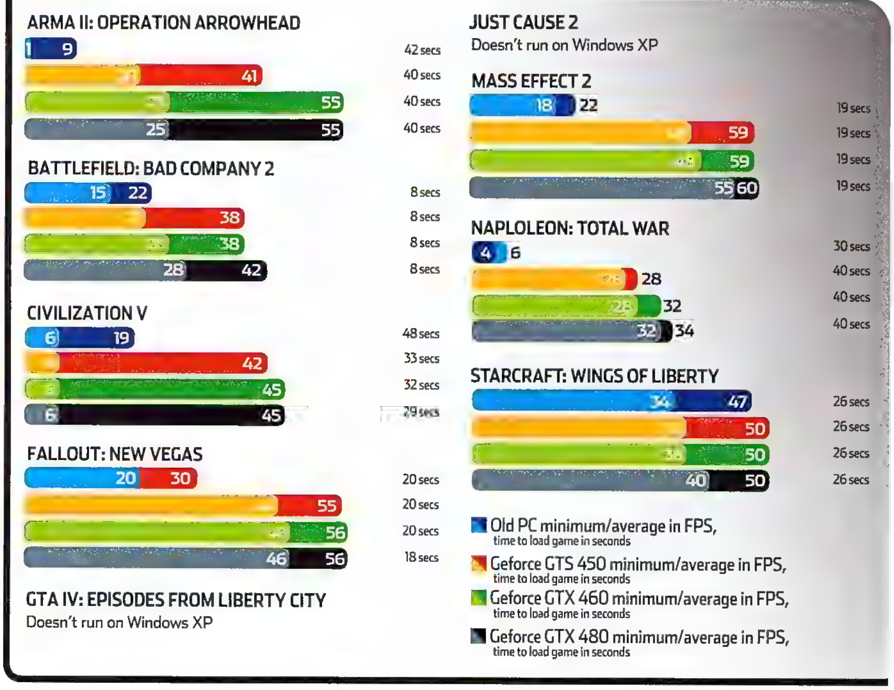
Upgrading the graphics card in a four-year-old PC should be relatively easy, but there are a few things that you should check before you whip out your credit card. First, you need to make sure your PC's power supply (PSU) has enough cables and can supply sufficient power for the new card. You'll need to open your PC case to check this – you're looking for the PSU's total wattage, which is typically somewhere between 200W and 700W for a PC of that age. If it's less than 400W, you'll probably need to buy a new PSU before you change the graphics card.

Also check that your PSU has the right type of cables for a modern graphics card. The GTS 450 requires a single 6-pin PCI-E power connector, for example, while the GTX 460 needs two of these and the GTX 480 uses a 6-pin and 8-pin PCI-E connector.

As modern graphics cards are much larger than their predecessors, it's also worth checking how much space there is inside the case for the new card. The GTS 450 and GTX 460 are both 210mm long, while the GTX 480 is 267mm long.

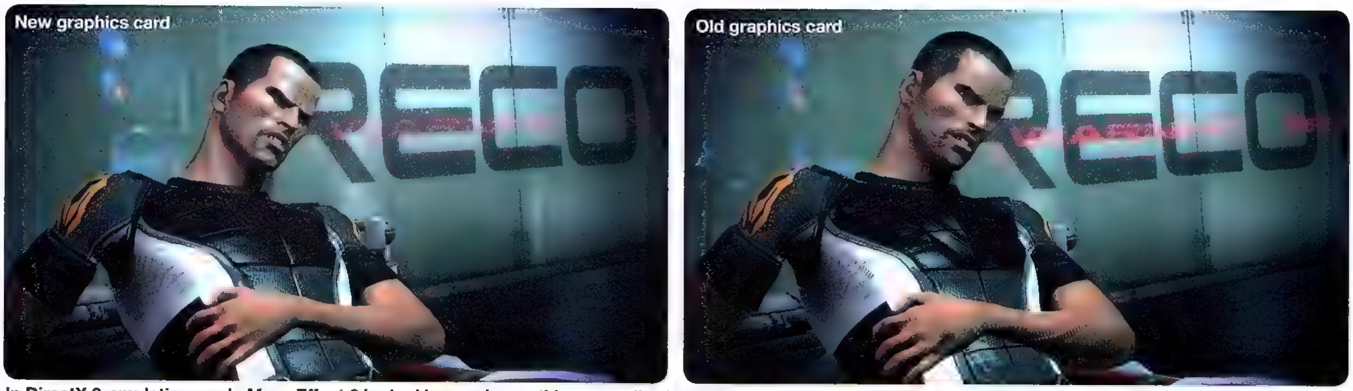
If your PC passes all these checks, you can buy and install a new graphics card. Leaving the old card in for now, you should uninstall its driver using the applet in the Windows Control Panel. Then – and only then – should you shut down your PC, install the new card, boot up Windows and install the new driver. This will ensure that Windows doesn't become confused and try to use the old driver with the new card.

Results



How much difference does the GTS450 make?

The four-year gap between the old 7950 GT XT and the modern GTS 450 was immediately obvious. The first game we tried, Arma II,



In DirectX 9-emulation mode Mass Effect 2 looked horrendous – this guy really shouldn't look like he has a tapeworm in his arm and cheek.

suddenly went from a jerktastic 1fps slideshow to a near-smooth 20fps. Admittedly, 20fps is still a few frames per second shy of the 25fps we're deeming playable but, even so, the GTS 450 was a staggering 20 times faster than the original graphics card.

With the exception of StarCraft II, which already ran smoothly on the old PC, the other games ran much faster on the GTS 450. However, not every game ran smoothly enough: Arma II and Bad Company 2 still stubbornly juddered along at just under 25fps. Civilization V's minimum frame rate refused to budge above 6fps with all three cards, which leads us to believe that this game just isn't very well coded, or that it needs a quad-core CPU. Either way, the terrible minimum frame rate isn't a disaster as it is in the other games, as Civilization V is turn-based rather than a real-time game. Finally, although the GTS 450 supports DirectX 11, the upgraded PC still wasn't able to play GTA IV and Just Cause 2, as neither game runs on Windows XP.

How much difference does the GTX 460 768MB make?

As we'd tried the $20-cheaper GTS 450, the GTX 460 didn't prove as much of a revelation. However, unlike the GTS 450, the GTX 460 was able to play all our games smoothly, bar the stubborn Civilization V. The GTS 460 doesn't only provide higher frame rates than the GTS 450 either; you should also be able to use some of its processing power to increase the detail settings in some games while still maintaining a smooth frame rate.

How much difference does the GTX 480 make?

At the opposite end of the price spectrum is the mighty GTX 480. It's almost three times the price of the GTX 460, so you might expect the GTX 480 to produce spectacular frame rates, but you'd be wrong. For instance, the GTX 480 ran Arma II, Civilization V and Fallout: New Vegas at exactly the same frame rates as the GTS 460. Even in Mass Effect 2 at its highest quality settings, the GTX 480 was only 7fps faster than the GTX 460, a card that already ran the game at a silky smooth 48fps.

The reason for the tiny performance difference between the GTX 460 and GTX 480 is that the latter is designed to work with modern quad-core CPUs and to run games at a much higher resolution than an old PC's monitor can display. This meant that the GTX 480 spent a huge amount of time twiddling its thumbs at the comparatively low 1,280 x 1,024 resolution of our example PC. As a result, it appears to be terrible value for money, but it's important to note that at higher resolutions the GTS 480 is much faster than the GTX 460.

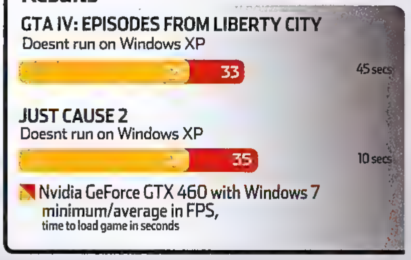
Upgrading: The verdict

Unlike the other components in our four-year-old example PC, the GeForce 7950 XT graphics card has aged very badly, and the system was only able to play one of 2010's best games – StarCraft II. Even the cheapest modern graphics card we tried, the $130 GTS 450, was between 6 per cent and 20 times faster, and was almost able to play many games. However, this feature isn't about upgrading your PC so that it can almost play games – it's about updating it to handle modern games with aplomb.

To make this happen, the first (and if you're strapped for cash), the only upgrade you should make is to buy a $150 Nvidia GeForce GTX 460 768MB graphics card (see above). Adding this card to our four-year-old PC was enough to transform the geriatric pile of silicon into an Olympic sprinter, making all but one game, Civilization V, run smoothly and enjoyably. In contrast, if you spent a similar amount of money upgrading the RAM or CPU, you still wouldn't be able to play most of the best games of 2010 on your old PC.

If you can also scrape together another $110 however, upgrading to the 64-bit Windows 7 Home Premium is another great upgrade. Not only is Windows 7 slightly faster than Windows XP, it also has a far superior interface, is more stable and secure and enables you to play DirectX 11 games, which is something Windows XP simply can't do no matter which graphics card you own. When we added both Windows 7 and the GTX 460 768MB graphics card to our old PC, we were finally able to play GTA IV and Just Cause 2 in the way their developers intended, as you can see in the graphs below.

Results



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GAMEPLAY

GAMES, GAMING AND GEEKERY COVERED... ATOMIC-STYLE

Christmas may be over, but that doesn't mean you can't buy yourself a present, does it? In fact, now is the time to pick up those games that you didn't find under the tree on Christmas morning, usually at lovingly discounted prices and without the massive queues you'd get in December.

Which is why we're not holding back on the game review front. We've got Assassins Creed. We've got GT5. We've got World of Warcraft: Cataclysm – the fastest selling PC game of all time. And more!

And if that's not enough, id's Tim Willets tells us all about the upcomig post-apocalyptic FPS, RAGE. And what he has to say gets us very exciting for the developer's first release in several years. At this rate, 2011 is shaping up to be a stellar year for gaming ...

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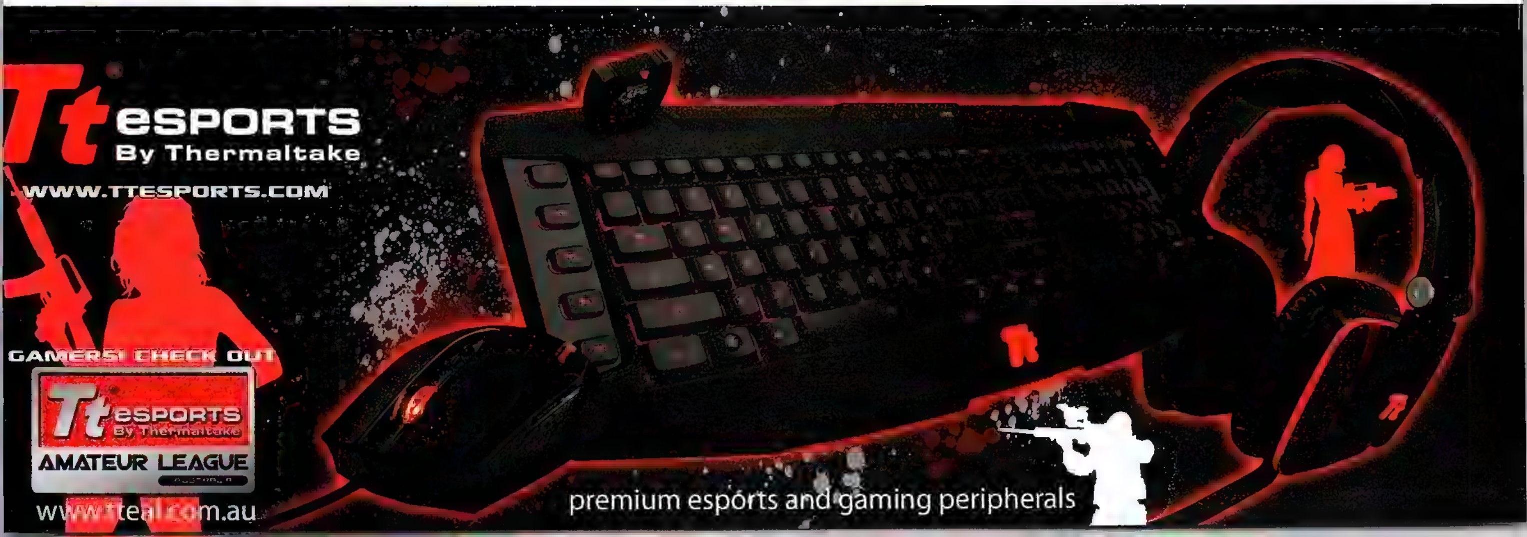
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RAGE – the id interview

We chat with Tim Willets on id's next big thing, the brand new fresh IP, RAGE...

There's a huge expectation hanging over id Software's RAGE. It's the developer's first game in years, the signature outing for the new id Tech 5 engine, and – arguably the most scary thing of all – their first new IP since Quake.

So there's a lot of nerves involved, and id is determined to get this epic post apocalyptic tale just right. It's been in development since 2007, and while the game is now largely complete, there's still a lot of work to be done before its September 2011 release date. Everything from texture sizes to camera positioning is being tweaked, tested, and re-tweaked to make the new game as smooth and polished as possible.

Tim Willits, Creative Director on the title and longtime id stalwart, took time out of his busy schedule to chat to us about the game, the testing process, and even the enormous prices local Aussie gamers have to put up with.

What's the plural for apocalypse?

Judging by the success of the various Fallouts and Borderlands' it's obvious that gamers love a good Apocalypse, and that's exactly what RAGE is going to deliver. That game's lot revolves around a post-asteroid impact Earth, and the sole survivor of a doomed Ark, or underground cryo-facility. While you've been literally chilling out underground, other Ark survivors have set up ramshackle towns, all the while fighting off mutant tribes and other nasties.

id's shifting up the usual FPS mix, however, to include not only vehicle-based gameplay, but also a lot of RPG elements, like inventory management, crafting systems, and customisable ammunition loadouts for the game's weapons.

It's quite a lot of balls to keep in the air, so that's where we started our chat.

"We're firmly in finishing mode," Tim told us. "The engine is more or less complete, so now we're working on performance, making sure the game hits a solid 60 [frames per second] all the way through." As we spoke, it was 4.30 in the US afternoon and he'd been hard at work getting the game through some serious testing. "It's that point where you have to say to people 'Look, I know this is awesome, but it needs to be cut out'. You need to be harsh sometimes."

There's also a lot of work being done on the driving mechanics. "We're fine-tuning the upgrades, the camera system, getting it all polished," he told us. "It's a new IP and we really want to get it right."

And that's a whole other challenge facing id – delivering a product that doesn't stand on a pedigree of great prequels or a known narrative, like Doom or Quake. "It's very liberating, though,"

Tim explained. "You can say let's do this that way, or let's do something else. It's much more open – there's no limitations holding you back."

"But it's also very frightening – we've got a whole new game and world to sell, and that's going to be a challenge. We're going to be really ramping up the marketing next year to make sure everyone knows what the game's about."

Bang-bang, you're exploded

There may be similarities between RAGE and the 2009 hit Borderlands, but a raft of slightly different but ultimately samey weapons isn't one of them. "We've got a limited set, a pretty traditional spread, but we will have some cool ammo types. It's about making the game fun, but also simple to approach, without just overloading the player with lots of little random things." These things include explosive ammunition, and crafted items like automated turrets or sentry guns that complement the player's style, without dictating it.

And speaking of crafting – or engineering, as it's called in RAGE – Tim's adamant that it isn't necessary to grind away hours at a time just to have enough ammo to kill the next boss. "There are one or two moments in the game where you need to make something to progress, but otherwise it's all up to player choice."

In fact, that's a central concept at the heart of the engineering mechanic. "There's something new to play with in every area," he said, "but we've also tried to make a lot of the components shared between different items. It's pretty easy to make whatever you like, depending on what you find useful and supports your game style.

That same level of choice is present in the game's driving sequences, which, while common, are by no means mandatory. "There's only a handful of essential driving missions – we really don't want to scare away hardcore FPS fans if they don't want to drive around," Tim said.

"That said, the car stuff is a lot of fun – it's very... id. We've done things like give players

From the character animation to what is likely going to be the industry-best lighting engine, id Tech 5 is looking really tasty.

the ability to control the car in the air following a jump. Now, that's not realistic, but it is fun. At the same time, we don't want players to be worrying about getting drifting just right. RAGE is not a sim!"

Then there are the vehicle upgrades, which are receiving a lot of love from the testers. "We did have a whole bunch of stuff at the start of the process, but that's been trimmed down. Sure, you can get new suspension and stuff like that, but ultimately what people really want are bigger guns and better armour – so that's what we've focused on," Tim said. "You'll be able to mess about with bombs, neat shockwave effects, and a lot of cool defensive moves."

"At the same time," he adds, "you can pretty much just use the driving to get from A to B, which is pretty simple. You're not going to get lost, and while we do have some dynamic content that'll get thrown up while you're behind the wheel, you can just ignore it and stick to the core gameplay if that's what you want."

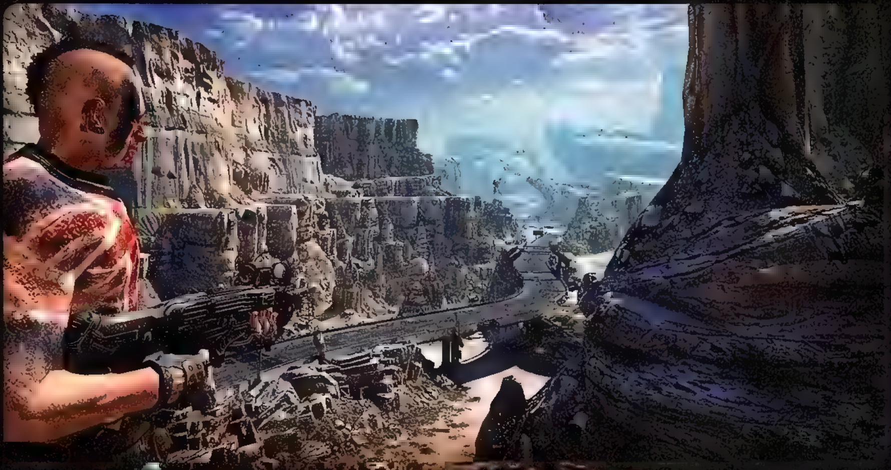
Under the hood

We saw RAGE in action last year at E3, and we can tell you – it's a bloody beautiful looking game. From the character animation to what is likely going to be the industry-best lighting engine, id Tech 5 is looking really tasty. But at the same time, RAGE is going to be released on PC and console, so we were quite curious as to what effect that would have on the kind of PC customisation options we know and love.

"On PC, don't worry – you'll get the full experience of the game, with the giant textures, complete AA options and the rest," Tim told us. "I've got a new Core i7 machine and let me tell you, RAGE looks great. The PC version will also ship with the full suite of tools for modding right out of the box."

It's not all great news, though, as John Carnack stated as early as 2009 that the game would not be going the dedicated server route. "Yeah, it's still out," Tim said when we asked if this were still the case. "We're not trying to screw anyone over, but the truth is when you step back and look at making a game this big, across so many platforms, it's just easier to unify the online architecture. I know a lot of PC fans don't like that, and I know what they're talking about, but it just makes sense."

In effect, it's as much of a business decision as it is a technical one. LAN connectivity is still sadly up in the air – the game's being tested over LAN networks, but the decision as to whether or not that's going to make it into the final game is still up in the air. "The decision is still uncertain due to cheating concerns and other issues," Tim told us. He must have sensed our reservations even over the phone, though. A lot of PC games are being released with comparatively limited multiplayer functionality. "As we finalise our multiplayer



plans I'll make sure to let everyone here know the concerns that you [and your readers] have brought up."

But the cross platform approach has brought with it a lot of other unique challenges. "It's very different, but since we're working with a brand new technology, it means we're not trying to shove old tech into new architectures. The Big Brain Group," which is what Tim calls id's inner circle around John Carnack, "looked at the current landscape and designed the engine from the ground up to work on anything. The vast majority of the code is identical no matter the platform. Some of the APIs are unique, of course, but most of the assets are the same," Tim added.

He went on to talk about the importance of a holistic approach. "For a game like RAGE, it's critical to go cross-platform, but that's not to say we're ignoring the PC. It still has the advantage in terms of input, and in the social nature of the platform – that's why games like World of Warcraft can only really work on PC."

"And then there's Farmville," he adds with a palpable sneer. "More people play that than any other game; it's a real PC success – what a sad state of affairs!"

Final thoughts

"From the get-go we've wanted to build a really total experience – there's a tonne of games out there, so we wanted to deliver one that's really big, really fun, and with a lot of cool stuff. Modern gamers expect more diversity and want to do more inside of a game, so we've delivered a story that can support that. When some puts down $60 for a game... Hey, what do you guys pay?"

Of course, we told him. "Holy... Buckets! Wow... well," Tim said, obviously amazed at Australian game pricing, "I can assure you we'll be making sure that even you Aussies get your money's worth in the game. I can tell you it's not going to be a short game, even if you ignore all the side stuff!"

And you know what? It strikes us that Tim's not the kind of guy to lie. RAGE will be released in September 2011, and we're really hopeful it's going to be something special. **DH**

Measure twice, cut once

It's a refreshing to talk to a developer that is so passionate about putting out a quality game, backed up by a thorough testing and quality control regime. This year has seen a number of inherently buggy releases of otherwise big-name titles. When asked about the importance of a solid testing process, Tim wasn't shy. "Most companies don't do enough of it," he said. "It doesn't matter how brilliant you think you are, but most of your ideas are bad. You need to be able to hear that, and throw that bad stuff away."

To illustrate, he told us about some testing he'd set up the day before our interview. "We're trying to get the cameras just right, especially for the driving part of the game. I thought we'd gotten there, but we got some of the Doom team over to have a look at what we told them were different cars and how they drove, but what we were really testing was camera angles. We had five guys, and all of them preferred a different angle to the one I thought was perfect."

"You just need to test stuff like that, be brave, listen to your testers, and change things accordingly.

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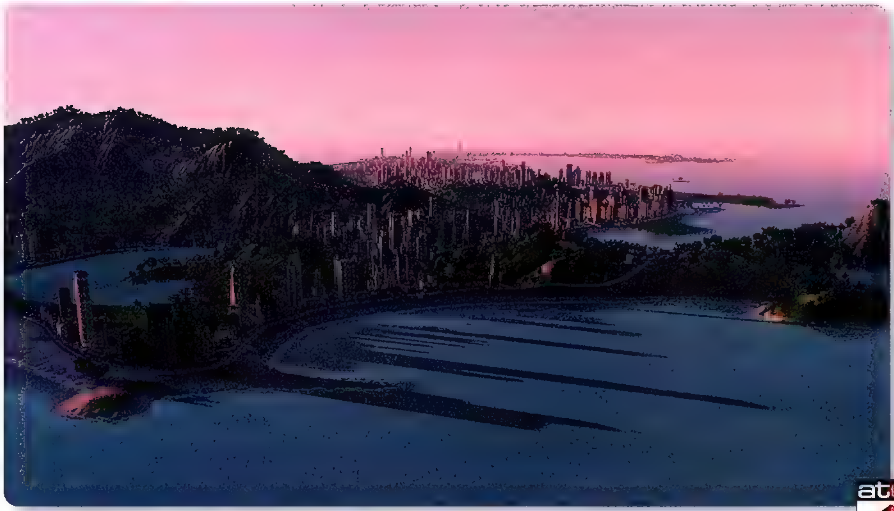
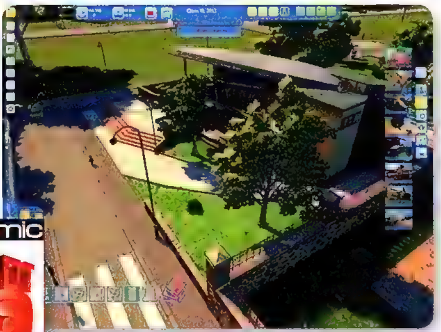




CitiesXL 2011

When is a game not really a game? And can such a beast still be an engaging distraction?

The first CitiesXL effort was an honest attempt at a truly unique combination of two gaming genres. But like the seemingly clever idea that has tempted marketers since time immemorial (two great flavours can always be combined to make a better flavour), the actual combo in Cities didn't quite stick – who knew that the perpetually online gameplay of MMOs wouldn't go with the ADD-tempting city sim?

Well, someone probably should have, because the online portion of CitiesXL really didn't take off at all. It was considered so extraneous as to end up being entirely excised from the sequel, CitiesXL 2011.

So, this of course begs the question – is building a pretend city by yourself any kind of fun for a grown man?

Mmm... zoning laws... *drools*

Well, the simple answer, at least from this grown man, is "Yes, of course it is – if I can spend 38 hours a day grinding pretend boars to make pretend food for my pretend elf, and enjoy it, what's the difference?"

Which, really, is stupid defence for the game – what am I thinking? In truth, while the idea of a more or less plotless, challengeless, yet highly detailed city building sim may sound rather daft on paper; in action, it's really quite addictive.

Actually, calling it challengeless is also bit of a furphy. There's nothing quite so directed as, say, trying to save your city from a mega-disaster, or reaching a certain growth level in a certain time – rather, the challenge is constant and more or less low level.

Each game starts simply – from a planet full of city types, you choose a zone and then lay down your first road, and first buildings (a town hall and simple utility building), and then go from there.

Even though a lot of the advanced building options are locked out until you reach the proper population levels, there's still a lot of choice in what to build, and even more choice in terms of where to place it. More often than not, however, your first attempt at city perfection will lead to a toxic environment full of collapsed businesses and bored/sick/angry/ill-educated mutants instead of citizens. That's okay – you need to learn good zoning and planning somehow, and if like us you can't stand doing any game tutorial, it's as good a time to learn as any.

Too, the lack of immediate direction might be off-putting for gamers that have been brought up on a steady diet of quest dialogues, lists of code-keys to find, or easily definable win-lose scenarios, but once you get into the swing of CitiesXL 2011 you'll find the pace oddly relaxing. That's because you pretty much set the pace to be as hectic as you want, as dictated by how fast or slow you want your city to expand.

As you do start add housing and places of work, maintaining the balance between available housing, jobs, and supply of workers can get tricky – go slow with it, and you can keep up with the inevitable demands of more workers or more housing, or the additional demands of shops, entertainment and good roads.

But the go slow approach will also mean you don't expand all that fast. But build faster and you risk not being able to meet an industry's demand of workers, or you might end up building a poorly laid out neighbourhood which in turn leads to traffic congestion lack of room for shops or medical centers.

As your city progresses you'll unlock new types of housing, new industries, and new levels of citizenry, from unskilled workers to executives, all with different social demands. Depending on your chosen map, you'll also have a different set of raw resources to exploit – or not, which leads to its own set of problems that need solving. As you build up a surplus of any given good or service, you can then start trading for what you're missing out on.

On top of all this delicate balancing and building, there's also a really quite impressive game engine, and a very scalable one. The game is stunning on modern hardware, but even stuff three or four generations off the boil will deliver solid frame rates and impressive visuals.

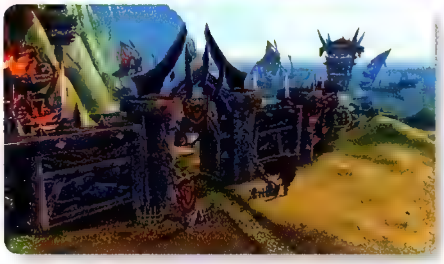
CitiesXL 2011 is obviously not going to appeal to everyone, but if you feel like losing yourself in the minutiae of your own city-wide empire, it's a truly elegant way to pass an afternoon. **DH**

PC

Developer Focus Home Interactive
Publisher Focus Home Interactive
Website www2.citiesxl.com/

Gameplay Slow-paced and aimless, but oddly engaging.	89
Graphics Excellent lighting and detailed – complete with cars and citizens!	93
Sound One of the most annoyingly addictive soundtracks.	88

Overall
We couldn't tell you why... but we're going to be playing a lot of this game.
90%



World of Warcraft: Cataclysm

Five more levels, one pissed off dragon, and a whole new world to explore. Welcome to the end of days, Azeroth style!

Traditionally, World of Warcraft expansions have upped the level cap, added new high-level regions to explore, and maybe a few new crafting professions and a new race or two. The Cataclysm expansion goes way further. In lore terms, the world of Azeroth has literally been shattered – coastal regions have been flooded or destroyed, cities attacked and buildings ruined, and the balance of power forever changed.

Every starting area and major quest-line has been updated to fit into this new world, while at the upper end of the game regions have opened up for level 80 players to start their advance to the new level cap of 85. So while the upper end of Cataclysm isn't quite as large as the ten-level-ranged Burning Crusade or Wrath of the Lich King, the overall changes to the case game are both vaster, and far more interesting.

For this review we've split the work between our high-level WoW expert, Liz Skuthorpe, and me, your humble Editor, who's been exploring just how messed up his beloved Night Elves are following the rise of Deathwing...

A whole new game

We can't stress enough how different Warcraft now feels. The new starter areas and Cataclysm-affected regions freshen up gameplay immensely. For a WoW veteran, the impact of seeing familiar areas like Auberdine shattered and inundated with evil elementals is oddly... harrowing.

At the same time, the changes to the game's base mechanics have well and truly gotten us hooked all over again. The new Talent system effectively does away with the dabbling of cookie-cutter builds and forces you to focus on one Talent group at a time. Professions have all been cleaned up, and the two new ones – Inscription, for making Glyphs and a range of stupidly useful scrolls, and the very cleverly implemented Archaeology – really round out the game.

And then there's the graphical upgrades. WoW is still ultra cartoony, but Azeroth and its attendant continents/worlds have never looked better. Lush grasses and shrubbery cover the ground, the view distance has been bumped up to officially 'hella impressive' levels and the water... well, it's got to be seen to be believed.

It's almost like devs at Blizzard have mugged someone from Crytek and stolen their liquid physics engine for a laugh.

The high end

Azeroth has been destroyed and Hyjal and Vashj'ir beckon but how do these new zones hold up in the New World Order? Our illustrious editor has covered the noob zones so let's have a look at what to expect for levels 80 through 85.

Blizzard learned a few lessons after the initial release of World of Warcraft and the Burning Crusade expansion. Focused narrative quest-lines were the order of the day for the second expansion Wrath of the Lich King, and the developers have continued in that vein for Cataclysm. All the new high-level zones; Hyjal, Vashj'ir, Deepholm, Uldum, Twilight Highlands, have quite a linear feel to the questing – which may be a negative if you like a more open sandbox feel, but you won't be lost for quests.

For higher level players the biggest change to the game will most likely be the new outlook on dungeon difficulty. Prior to the expansion Blizzard hinted that the easy-days of chain-pulling through heroics would be dead in the water come Cataclsym, and that is certainly true. Dungeons and heroics have seen a return to crowd control, so it's time to keybind that Polymorph, Hex, Banish or Entangling Roots spell (here's a hint, it's in your Spellbook).

And those elite dungeon mobs hit like Mac trucks driven by angry bears – which means both tanks and healers are feeling the strain and the challenge. All in all, it means that heroics feel they way they should – really hard, and satisfying to complete. You'll also need to get those regular dungeon 'Blue' rewards before you can think about heroics. And you'll need those heroic rewards before you can think about raiding. Easy-mode is gone, and it feels glorious!

Which pretty much sums up our feelings on the entire expansion. Now, if you'll excuse us, we need to go see a man about some boars...

DH&LS

PC

Developer Blizzard Entertainment
Publisher Activision/Blizzard
Website www.worldofwarcraft.com

Gameplay Still addictive, but now totally refreshed.	92
Graphics A huge improvement, and that water... whoa.	86
Sound Still some of the best music in gaming.	90

Overall
As if we needed more proof that Blizzard's at the top of its game...

90%

Assassin's Creed 2: Brotherhood

Ezio's next big Italian adventure.

When is a sequel not a sequel? Stuart Black, creator of Black and possibly Bodycount (if it comes out), thinks that the concept of considering games as similar to films is actually quite a poor idea. Better to consider a game as like a TV show – episodic, with its own ebb and flow within that episode, but on-going within the over-arching plot. But what does this actually have to do with anything? Well, movies get sequels, TV shows get seasons. So, going back to our initial question: when is a sequel not a sequel? When it's actually Season 2.

And that's exactly how Assassin's Creed 2: Brotherhood feels. Starting immediately after the cliff-hanger ending of Assassin's Creed 2, Brotherhood (or AssBro as it's affectionately known) throws you back into Desmond's shoes as he and the other Assassins flee to Monteriggioni – the villa that Ezio spent so much time and money repairing in AC2.

Once you're set up (with a short Desmond free-running mission to keep everything a little fresh) it's time to jump back into Ezio's time. It's here in 1499 that it's obvious just how much work Ubisoft have put into this title. Ostensibly, the core game mechanics are the same in terms of free-running and combat, but additional elements make this a very different game to its predecessor.

Rome is in the grip of the Borgia, who subjugate the populace and have allowed the city to fall into ruin. To win back the hearts and minds of the Romans, Ezio must destroy the Towers that symbolise the Borgia rule, opening up areas of Rome for him to upgrade, much like the Villa from the AC2.

Unlocked area will also eventually give you access to new Assassin recruits taken from the disenfranchised members of the population. These become a squad of sorts, with Ezio able to send them out on missions around Europe, gaining experience and letting you increase their weapon and armours skills and thus their effectiveness in combat. They can all be called in to assist Ezio in combat or just for the sheer cool factor of having someone else do the assassinating for you.

Other new gameplay elements include more stealth-based missions. After reconnecting with Leonardo Da Vinci, you learn that the Borgia have forced him to create weapons of mass destruction – flying bombers, tanks, machine guns and more. Destroying these is essential to taking back Rome, but the missions will desynchronise if you're detected.

Combat has been tweaked mildly too, with new weapons including the crossbow for silent ranged executions, the capacity for Ezio to carry heavier weapons and a killstreak mode for seamless killing of multiple enemies in combat. Sadly, just like in AC2, Ezio can easily take care of enemies simply by relying on the hidden blades and the counter manoeuvre or even the disarm, making the new weapons interesting, but hardly essential. Similarly, free-running Ezio still has the occasional urge to ignore controls and frustratingly leap into the wild blue yonder.

Multiplayer has also been introduced, with a very clever concept behind it. The multiplayer elements are actually portrayed as being a training simulation for Templars. The basic concept has you using stealth and assassin skills to take out your targets – an extremely welcome change from tearing around at breakneck speeds with machine guns.

While it could be argued that Brotherhood doesn't add anything major to AC2, that would be missing the point a little. No, it's not the Assassin's Creed 3 that we may have been hoping for, but it's an extremely well rounded title, with excellent gameplay and just enough new elements to ensure that, as Season 2s go, this is a true killer. **NH**

PS3, Xbox 360 (reviewed on Xbox 360)

Developer Ubisoft Montreal/Annecy
Publisher Ubisoft
Website www.assassinscreed.com

Gameplay Clever, fresh, but with some of AC2's flaws.	92
Graphics If anything, AssBro looks sharper than AC2.	95
Sound Just like Mama used to make!	90

Overall
A game that continues the fun and builds on its predecessors strengths

93%

Need For Speed: Hot Pursuit

The Burnout developers are set lose on a venerable franchise.

EA made a really smart move a few years ago and split the Need For Speed franchise into several different games. Last year's Shift was a nod to the sim crowd. Hot Pursuit on the other hand harks back to its arcade racer roots, borrowing a name from the beloved original cops vs racer spin on the game.

EA's smartest move, though, has been putting Criterion in charge of Hot Pursuit. It does mean we have to impatiently wait for a new Burnout, but the game has been made by some of the best craftspeople in the arcade racer business.

But be clear, this isn't another Burnout Paradise. The game is structured around a series of menu-based events, and while there is a free roam mode it is purely a testbench for your garage. This strangely hollow area of the game ends up largely ignored, and we can only assume that this will be the landing site of the inevitable DLC.

There are actually two parallel 'campaigns' to be played. You can go down the cop path, levelling up, unlocking pursuit cars and new cop events. At the same time you can level a racer character. This increases the amount of events to choose from at any one time, and though favouritism will inevitably develop (this writer enjoyed the cop parts much more than racing) you can always jump roles when a particular race gets frustrating.

Cops get access to a series of fantastically ludicrous pursuit cars, with an interchangeable assortment of American made tin cans soon giving way to Lamborghinis and Maseratis. Events swing from having to take out a bunch of hostile racers (much fun) to time trials in which you need to drive a supercar to the end of a stretch while undertaking minimal damage

(less fun). At any time there are a pile of new events available, but you can easily run out of new pursuits and have to bash through several time trials to unlock new ones. It's mildly frustrating, but not game breaking.

Racers are on the other side. Their events involve things like outrunning cops, or some tight one-on-one races. The car selection is largely the same as the cop one, but at least this time you can change colours.

Once you stumble through skipping the intro to each race, the driving is classic Need for Speed. You do need to use your brakes occasionally, but mostly you will be at or near top speed, flinging yourself down the road. The driving model can't be faulted, drifts are tight, weather has an effect and the more powerful your car, the more you need to be on your toes.

Dangerous driving is encouraged through the turbo system. Racers generate turbo by driving on the wrong side of the road, using shortcuts and stylish driving. Events are usually well balanced, and judicial turbo use is an almost compulsory part of victory, especially in time trials.

Criterion has nailed high speed vehicular combat brilliantly. It is still short of the devious AI seen in Bizarre Creation's Blur, but it is tight and tense. Cops have spike strips and homing missile style EMPs for offense, and can call in helicopters and roadblocks to slow down racers. Cars tend to take a fair bit of damage to take out – takedowns are cop goals and incidental when racing. Racer's arsenals are more defensive with extra turbos and jammers added to the weapons.

Graphically the game has the trademark Need for Speed slickness, with overt environmental effects and smooth framerates. It looks especially good on the PC, which is a shame because Criterion recently indicated that the PC was a very low priority when it comes to DLC. After burning anyone who bought Burnout Paradise on PC by barely releasing any of the game's extensive DLC for them, we don't hold out much hope that PC owners will be better served this time around.

Multiplayer and online integration is very well implemented, and better if you have friends that own the game. It builds up leaderboards for every event from your friends list, and can even recommend friends for those who don't feel like having to be a viral marketing arm of EA's to get a high score list. It is a nice addition to the normal assortment of multiplayer features for those who focus on the single player side of things.

Hot Pursuit is a really solid arcade racer. Criterion has nailed the combat, and ensures that players are rewarded regularly with new cars, upgrades and events. There are some mild frustrations like the gaping hole that is the freeroam mode, and the selection of events but this is a very solid overall effort. Ultimately Blur did the vehicular combat thing better, but the pull of the cops vs racers adds a lot. This isn't a great game, but it is a bloody good one. 2010 was a standout year for the arcade racer, and Hot Pursuit doesn't quite stand head and shoulders above its quality competition. **JG**

PC, PS3 an Xbox 360 (reviewed on PC)

Developer Criterion Games
Publisher Electronic Arts
Website hotpursuit.needforspeed.com

Gameplay High speed arcade racing, but with a vacant free roam mode.	82
Graphics Gorgeous environmental effects and a damn good sensation of speed.	81
Sound Forgettable music overshadowed by throatily great car sounds.	81

Overall
Not quite a classic, but still a damn good time.

84%

Gran Turismo 5

The Real - *ly long in development* - driving simulator.

Gran Turismo 5 has been in gestation for an excruciatingly long period of time. After five years' development and many infamous and frustrating delays, we finally dive head first into Polyphony Digital's world of motoring. And what a huge world this turns out to be. The game contains a crazy 1,000 cars, over 70 tracks – both new and old – as well as a variety of racing styles to sample.

As always GT is just as much a homage to the motoring world as it is a video game. Polyphony Digital love and respect their cars and this passion shines through. They also love to do things their own way. A lot of time has passed since the old GT games were the racing benchmark and games in general have progressed a similar distance. PD seem to have ignored many of these advancements, and while this ensures that great old GT feeling and structure is still there, it also makes the game feel somewhat behind the times. The user interface is slow, clunky and frustrating to navigate and the frequent loading screens are tremendously tedious and disrupt the flow of the game.

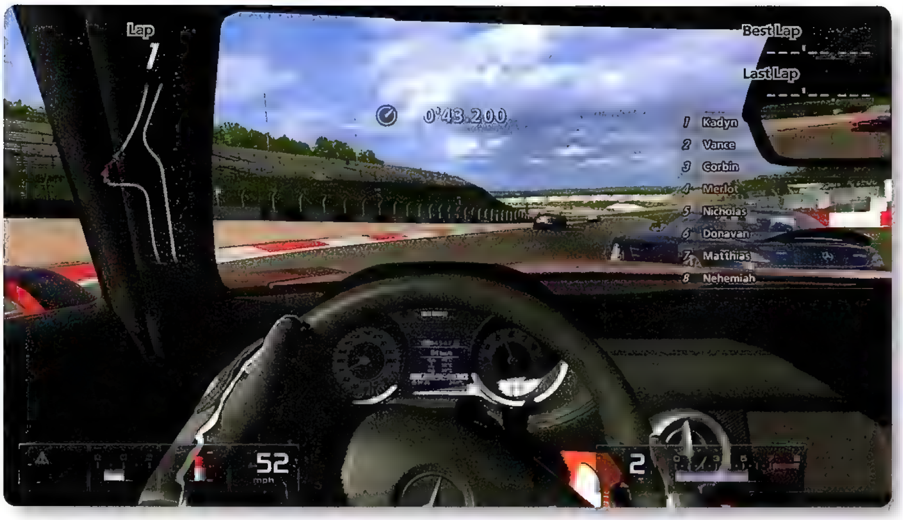
Jump in my car

Of the 1,000 cars in the game, only 200 are what PD call premium models. These were created from scratch for GT5 and are painstakingly modeled, include fully realised cockpit views and are just plain stunning to look at. The other 800 'standard' cars are rejigged and upgraded cars from previous GT entries and do not have the option of a cockpit view. Many of these standard cars look great given the quality of the original models but some really show their PS2 heritage and look out of place next to their premium brethren. The same goes for the tracks in the game, most of the time they are utterly gorgeous with some great lighting and effects, however on the odd occasion they can seem a little flat and unfinished.

The collection of cars and tracks offers great variety and authenticity but the visual inconsistencies are slightly disappointing given the time in development; it almost seems like PD bit off a bit more than it could chew in cramming so much content into the game.

GT Life, as always, is where the meat of the GT experience lies, but GT also features an Arcade mode, photo mode and Gran Turismo TV. Arcade mode offers a selection of the game's premium cars, three difficulty levels and access to all the tracks contained in the game. This mode is a great way to sample the driving in GT5 without having to worry about the intricacies and involvement of GT Life. Gran Turismo TV lets you purchase and watch various motoring clips and photo mode allows you to take your cars (limited to premium cars only) and stage them amongst some of the beautiful backdrops the game serves up.

GT Life lets you compete in a series of tiered races in order to win money and experience in order to buy more cars, tune and modify them and then do it all over again. Players do this in either A-spec or B-spec. B-spec sees you in a management role where you guide an often stupid AI racer around the



track prompting him to speed up, slow down, overtake etc. We didn't find this mode overly alluring but it is a good way to earn cash and experience in the ongoing grind into the upper levels. A-spec sees you behind the wheel in full control of your expensive beauties. The events in both modes are the same and while cash, experience and prize cars are shared, progress in each is discreet so that finishing an event in B-spec does not mark it off the list in A-spec. Experience points, which are new to the series are the main way of progressing through GT Life. Entry to events and access to cars are tied to your XP level. Licence tests make their return but, due to the new XP system, aren't mandatory or tied to the games advancement. They exist instead to provide solid development of skills in order prepare you for the more difficult events.

Thrown in alongside this are the GT special events. Challenges including Kart Racing, Nascar, Rallying and cruising down the wonderful Nürburgring Nordschleife await in this mode. These events are extremely rewarding, often frustrating, but provide great variety, encompassing many different styles of racing that really round out the overall package.

Turn it up to 11

Early races are a matter of buying an overpowered car for its class, cruising to the front and staying there. However, as you progress the difficulty is ramped up and races are much more dependant on skill than just having the slickest ride. The game can get quite unforgiving later on. Tiny mistakes in the heat of battle can send you out of a race in a fraction of a second and when this happens toward the back end of a race, well, it's just lucky our wheel was clamped to the table. There are a number of driving assists that you can turn on in order to make the game more accessible but it's extremely rewarding to stick it out with the assists off.

PD decided to have damage unlock at level 20. This seems an odd decision and also means that the usual GT tactics of bouncing off cars to overtake is still an often successful tactic early on in the game.

The AI is an improvement over previous versions but still frustrates and often wants to stick to its predetermined racing line no matter what the other cars on the track are doing. This results in some frustrating spinouts as the AI, oblivious to your actions, will nudge and throw you off track.

The driving model is as strong as ever, though. The feel of the cars, how they throw their weight around the track and the sense of speed is great and you're able to notice the subtle and not so subtle differences in how cars handle. The game controls well with the dual shock controller but the experience is enhanced tremendously by the use of a good force feedback wheel. That's when GT5 really came to life, as we fought against the cars around corners, felt them lose traction and were completely immersed in PD's racing world.

The game is a thrill to play and despite the inevitable hint of disappointment from a title with so much expectation and promises behind it, PD has succeeded in delivering a top notch and exhilarating racing experience. The thrill of the track is somewhat diluted by the overall presentation and certain design choices, but the bits they got right happen to be the important ones. Gran Turismo 5 often frustrates, but we're hooked on the driving and the world PD has lovingly crafted. A must have for the motor racing connoisseur. **DW**

PS3

Developer Polyphony Digital
Publisher Sony
Website www.gran-turismo.com/

Gameplay Wonderful but frustrating driving.	85
Graphics Beautiful but inconsistent.	82
Sound Solid but unremarkable.	79

Overall
A brilliant racing game wrapped in a somewhat clunky package.

83%

BLU-RAY

Inception

It's time to fall asleep and dream of Leonardo di Caprio...

Director Christopher Nolan
Starring Leonardo di Caprio, Joseph Gordon Levitt, Ellen Page, Tom Hardy

One of the things we enjoyed most about Inception when it hit cinemas last year was just how much debate it triggered. With its ambiguous ending – both in a narrative and ethical sense – and its exploration of the nature of both the mind and dreams, it got people talking more than anything else that we saw in 2010.

So, how does it hold up?

Very well, actually.

First off, the Blu-Ray release looks and sounds amazing. Hans Zimmer's score is emotive and powerful just through the TV speakers, but anyone with a home theatre set up will be especially impressed. Visually, it's a gorgeous film to look at, no matter the size of your TV. One of the interesting things about Inception is that, for a movie about dreams, it was actually quite subdued in terms of special effects. Most of the dreamscapes draw on fairly every-day locations, and while it can be argued that they've wasted an opportunity to go nuts on the visuals, the movie is better for the restraint. It's a credit to writer/director Christopher Nolan that he doesn't go the flashy spectacle route, but instead focuses on the story he's trying to tell.

That story doesn't always work – although it's a lot better on re-watch, as you spend much less time wondering what the hell is going on. We had much more of an opportunity to appreciate the characters, too. The interplay between Arthur and Eames is especially charming, and not just because Joseph Gordon-Levitt and Tom Hardy have great chemistry as good-natured foils. Ellen Page's Ariadne is the weak link; her role seems to be limited to exposition and poking around Cobb's personal and dream worlds without being asked to – although we did like it when she folded Paris.

We're not fully sold on the subplot between Cobb and Mal either. While it is certainly emotionally effective, especially when you realise that the reason she may seem unlikeable is because she is a projection of his guilt, it doesn't quite seem to fit in what is otherwise a mostly cerebral movie.

Christopher Nolan obviously spent a lot of time working out the various rules by which inception and extraction and the whole dream-manipulation works, but while this makes for a rich and thoughtful story, it can sometimes bog down the movie in exposition and explaination. And whenever you create such a strict structure, you're also leaving yourself open to making a lot more mistakes. There were moments where our inner nit-pickers were struggling to get out and run rampage, and it was only the fact that the movie was so entertaining that held them at bay.

Which pretty much sums it up. Inception is far from the perfect movie, but it manages to be fun and thought-provoking enough for it not to matter.

The standard Blu-Ray release gives you the movie and what is called Extraction Mode. Watching the movie in Extraction Mode pauses the movie at various points and plays a series of behind-the-scenes featurettes. It's a fun way of adding a bonus features, but given you'll want to watch the movie through first – the featurettes aren't spoilery, but no movie benefits from being stopped and started like that – rewatching it to see the new material can be a little tedious, even if you really enjoyed it. There is an option to skip right to the featurettes, but it didn't seem to play nice with our PS3. You can also get multiple-disk special editions which include additional extras like photo galleries, online comics and more featurettes. Depending on where you buy, retailers are throwing in postcards and other little bonuses – and it's already on sale pretty much everywhere for not a lot of dollars.

Inception makes a worthy addition to any Blu-Ray library. It's a well-realised release, and this is one movie that is rewatchable enough so you can be sure it won't be gathering dust on your shelves for years to come. Just try to keep your inner nit-picker quiet. **EG**

Overall
An epic mindfuck, though close attention is not always wise...

89%

atomic
MAXIMUM POWER COMPUTING

CULTURE SHORTS

Comic fans rejoice! The long-running comic series Powers is being made into a TV show by the usually nice people at US cable network FX. Details are sketchy but Charles Eglee, Executive Producer of The Walking Dead, is set to be involved.

Iron Man 3 will not be directed by Jon Favreau – the man who steered the first two films to success. Understandably, the internet is up in arms, but we might wait to see who replaces him before getting too distraught.

In big science news, NASA announced last month that they've found a completely new life form down here on earth. The new bacteria is based on Arsenic – which is not one of the recognised six building blocks of life.

Now that Torchwood is a US-UK co-production, the fourth season is getting a whole new flavour. Russell T Davies is joined in the writers room by Jane Espenson (Buffy, BSG), John Shiban (The X-Files) and Doris Egan (Dark Angel). Look out for it later this year.

The best reason to buy an iPad

Your favourite technology magazine now has an iPad edition featuring everything you love in the magazine plus exclusive extras each month including additional photography and video. Change the way you view your tech. Head to iTunes now to download the app.

What the hell's going on? What are these random articles?!

Well, it's simple - as part of our 10th Birthday celebrations, we're reprinting the work of some of our best writers. We're hoping it'll be a walk down memory lane for the old-timers, and a really neat insight into the mag for more recent readers.

Plus, we're curious to find out what the best Atomic article of all time is... so have a read, and fire me an email with your thoughts. And keep an eye out for future retro articles in upcoming issues. The year of Atomic is just beginning...

- dhollingworth@atomicmpc.com.au

Logan Booker, Atomic #46,

The genesis of a genre

We love games for the entertainment they bring to our otherwise normal lives. Surreal worlds, alien invasions, world wars – games have the power to make them real. First person shooters have led the way in many regards, but at what cost? Logan Booker delves into the lives of the giants behind the revolution that is the FPS.

Drop your mouse and move away from your keyboard. Let go of reality and imagine the entire genre of the first person shooter does not exist. Erase it from your memory.

Having trouble? Here's some food for thought.

There is no id, no Carmack, no Romero. No Doom. Epic Megagames is renowned for its seminal platformer Jill of the Jungle. Blue Sky Productions' Ultima Underworld never sees the light of day and consequently, there is no Looking Glass Studios. Raven is stuck developing crummy action games, Valve was never founded, Gabe Newell stayed with Microsoft, and 3D Realms is still Apogee.

Fun, at least in this world, has been expelled from the industry like *steam* from a release *valve.*

> The developers behind those original, truly revolutionary games are as intangible as the intellectual property they created – while the engines live on, the developers are forgotten.

But it's easy to paint an apocalyptic picture of a games industry minus its leading lady, barren of innovation, considering the massive influence it has had.

FPS games are the beating heart, the flawless gem, of computer entertainment. They are the powerhouse money makers of the games industry. Every year the genre delivers a new revolution in graphics or gameplay innovation, while preserving its heritage in the only way it can – the use of a first-person perspective. FPS is gaming's greatest success story, the industry's *Iliad*.

Success however, always has its wicked way with the humble.

With exception of people like John Carmack and Peter Molyneux, the developers behind those original, truly revolutionary games are as intangible as the intellectual property they created – while the engines live on, the developers are forgotten.

The days of 'John Romero's Daikatana' and 'Sid Meier's Civilization' are truly over. Design is a process – a step – not law, and the industry is now the domain of a select few big name publishers and developers.

So then, where did everyone go?

Gobble-gobble

During the nineties, there was a mass consolidation of game studios and publishers – it's perhaps the biggest reason why today's industry is as desolate as it is.

The Nineties, arguably the golden age of gaming when hits such as Quake were blossoming on the market, was a busy time for both gamers and businesses. Infogrames, who many will fondly remember as the grandfather of the survival horror genre thanks to its stellar Alone in the Dark series gorged itself on the likes of Shiny, Psygnosis, Gremlin, Ocean and Accolade. These acquisitions however pale in comparison to Hasbro, which Infogrames devoured back in January of 2001. Hasbro itself had been busily munching on MicroProse and ironically, Atari.

For a time, Infogrames and GT Interactive were the players in the industry – in the PC space anyway – up until Infogrames acquired GT in 1999.

May 2003 saw Infogrames change its name to Atari - a change that to gamers may have made sense, but to everyone else was bizarre. Atari, while it was a strong brand, was not a strong company – in 1998 it was sold to Hasbro for only US$5 million, a victim of its own frivolous spending and poor market decisions.

Technically, many developers are still around – they're just not independent. If you scratch under the surface of just about any big name publisher, you'll find traces of old and familiar studios. But, while studios can be easy to chase down, people are a little harder.

FPS: A Tragedy

The history of first-person shooters is as much filled with grand success as it is littered with broken promises and wasted potential.

During an IRC chat session five years ago, 3DRealms' Scott Miller bravely predicted Duke Nukem Forever would be the best selling game of 2000. At that time, DNF had been in development for four years, bringing total development time to almost nine years today.

Nine years ago, Tom Hall, William Scarboro and Jim Dose started work on Prey – a game that would never be published, let alone finished. Prey burnt through a lot of developers, including its original lead Tom Hall, his replacement, Paul Schuytema, and Paul's replacement Corrinne Yu, not to mention a substantial quantity of programmers, level designers and artists.

Twelve years ago, a sprightly 17-year old Ken Silverman began coding Build, the engine that would later power Duke Nukem 3D and Blood. Both teams that worked on these games were as paranoid as hell that one would steal ideas from the other.

A massive 13 years ago, Tom Hall penned the original design document for Doom, a design document that, for the most part, was ignored when Doom was developed, and, 14 years ago, Origin Systems Incorporated published Ultima Underworld, the first game to use proper 3D – a game that technically was light years ahead of Wolfenstein 3D, released a year later and Doom, released two years later.

However, Underworld is hardly considered today as a pioneer of 3D FPS gaming, and is one of many innovative titles unintentionally shoved into the background of FPS history.

Brave new underworld

Doug Church, who worked as one of the main programmers on Ultima Underworld and later as the project lead on System Shock, still remembers his time at Blue Sky Productions during development of Underworld. All 22 months of it.

'At the beginning, we didn't have a schedule as Origin didn't seem to think we could do it ... I doubt we thought it would take that long though,' says Church, now technical director at EDIOS Interactive.

Underworld, a role playing game based in the Ultima universe created by Richard Garriott, put the player in the shoes of Garriott's 'avatar' on a quest to save a princess. A little known fact is that Blue Sky approached Origin, who then supplanted the Ultima world into the game.

The technical concept was the brainchild of Blue Sky's Paul Neurath, who believed that a RPG built using a 'simulator' like engine had a lot of potential. So, in May 1990, work began on the engine and Dan Schmidt, who would later go on to code Terra Nova: Strike Force Centauri, a squad-based title with an emphasis on tactics, for Looking Glass Studios, joined the fray.

'The team was mostly brand new, so we certainly had a lot to learn. We were pretty much just designing as we came upon issues in blending flight-sim and dungeon crawl, so there was a lot of fairly open-ended "Well, that didn't work, try again" kind of rework. I don't think of that as a problem though, not at the team size of the time,' says Church.

But Underworld was an ambitious project. 'We had an engine that tried to do more visually and thus required faster hardware [than Wolfenstein 3D, id's famous claim to FPS fame] and had more issues – though it also had more possibilities,' explains Church.

'We probably had a smaller market

of HW [hardware] in the first place, but more relevantly, we had a much less focused game.'

Wolfenstein 3D and Underworld appealed to different audiences – one was just larger than the other. Church also notes that id's Carmack always made good compromises between advanced technology and hardware expectations.

'[id's] work had a huge impact on tons of people [and their] perception of 3D games ... [it] deserves to be remembered as a pivotal game as far more people played, looked at and remembered it and its descendents than people remember the few games of the type we did.

'I certainly hope we influenced some players and developers, but really, the main goal is just that a lot of players had a lot of fun.'

Breaking new ground

Shortly after the release of Ultima Underworld, Blue Sky Productions changed its name to Looking Glass Studios. Under this new name, the company produced its most enduring classics – System Shock, a title with a brilliant mix of terror, sci-fi and RPG; and Thief, a sword-fighting sneaker that encouraged the player to hide, not kill. LG also developed Terra Nova: Strike Force Centauri.

Terra Nova, while arguably as innovative as the aforementioned titles, ultimately didn't make the final cut.

'Terra Nova was very late,' explains Jonathan Chey, managing director of Irrational Games down in Canberra. Chey, a 10-year veteran of the games industry, was snapped up by Looking Glass to fulfill a role as an AI programmer. At that time, Chey had just completed his PhD in Cognitive Science at Boston University in the US. 'It was a dream come true and the luckiest break I've ever had,' says Chey.

Irrational worked with LG during the development of System Shock 2, sharing the technology behind Thief to produce the sequel. Like System Shock, Terra Nova was a foray into the realm of the sci-fi shooter, but, like all Looking Glass games, it wielded a depth of gameplay not found in competing titles.

'I think it took around four years to build – by which time the engine was already looking quite dated. It did do some nice things like drawing terrain to the horizon rather than using a static backdrop, but overall it just couldn't compete against other technology that was around by the time it was released.'

There was no lack of competition in 1996 – the year the game made it to stores – and included 3D Realms' Duke Nukem 3D that took the 'babes and big guns' legacy of the platformer and made it 3D; Raven's Hexen, a Doom-based shooter with swords and magic; Bethesda's Daggerfall, a deep RPG set in a massive, dynamic world, and of course, id Software's Quake.

'The rather backwards technology was a problem, for sure ... it [also] wasn't properly marketed and I don't think people understood what was interesting and different about it,' says Chey.

Perhaps the most unfortunate by-product of Terra Nova's legacy is Dan Schmidt. As mentioned earlier, Schmidt worked on Underworld as a programmer, alongside Doug Church and Paul Neurath.

'Dan was definitely the driving force behind Terra Nova. So much so that I think he burned out a bit on it. [It] might be part of the reason why he left Looking Glass soon after and went to work at Harmonix'

'Nice guy, smart guy – [a] good person to work with,' says Chey.

Thief in the night

Terra Nova was by no means the last game to come out of Looking Glass. In 1998, the company graced the FPS world with Thief – a game many believe was the catalyst for the genre of the 'first-person sneaker'. Thief was developed using Looking Glass' Dark engine, created in-house by the duo of Sean Barrett and Doug Church.

ABOVE: Ultima Underworld was in part the work of EIDOS' Doug Church, as was System Shock.

'LG was ideologically opposed to licensing technology. They felt that they could do better than anyone else. That's what made their games so unique,' says Chey.

'In retrospect I think it hurt the company ... Looking Glass was very resistant to copying ideas from other companies, too much so in my opinion. It did result in a lot of innovation but also, I think, kept them from keeping up with good ideas that other people had.'

To demonstrate, Chey uses the example of LG's default key configuration. 'For a long time LG insisted on defaulting their movement keys to ASDX instead of the industry standard WASD. There was no doubt some highly compelling reason, but it is foolish to violate an industry-wide standard like this in my opinion.'

In the case of Thief, violating standards was wise. The game, originally called 'Dark Camelot', was to be a relatively straightforward 'sword-fighting simulation' that made use of proper physics to enhance its realism. Chey compares Thief's earlier concept for combat to that found in another game, Die by the Sword, where the mouse was representative of the player's sword arm.

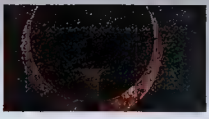
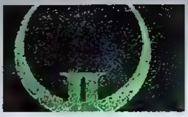
'For some reason, this concept never really got off the ground and the game got turned into a "sneaker",' says Chey.

'The actual moment that happened was late one night in the programming pit when LG CEO Paul Neurath just came up with the idea out of the blue. I think everyone immediately recognised that it was a great idea and the whole project shifted gears.'

Chey admits that it wasn't clear whether the concept would actually work. In fact, the only time he remembers having fun playing Thief was a few weeks before the game was completed.

To its credit, Thief has spawned two sequels – The Metal Age and Deadly Shadows. The Metal Age was the last Thief title to be developed by Looking Glass, and Deadly Shadows, released in May of this year, was made by ION Storm.

'Thief itself wasn't a huge hit – as is often the case with this kind of innovation, it's someone else who comes after who manages to take the proven

Wolfenstein 3D era (1989-1992)	Doom era (1993-1994)	Original Quake era (1995-1996)	Quake 2 era (1997-1998)	Quake 3 (1999-2001)	Doom 3 era (2002-2004)
					
Ultima Underworld Ken's Labyrinth	System Shock Terminator: Future Shock Rise of the Triad Heretic	Prey Terra Nova: Strike Force Centauri Duke Nukem 3D Blood Shadow Warrior Spec Ops: Rangers Lead the Way Daggerfall Dark Forces Hexen	Unreal Dark Forces 2 Hexen 2	Unreal Tournament System Shock 2 Thief Thief 2	Morrowind Unreal Tournament 2003 Unreal Tournament 2004

ABOVE: William Scarboro played a key role in the development of both Prey and Rise of the Triad. His death was a big loss to the industry.

mechanic and spin it into something more polished and commercially successful.'

Shock to the system

It was during the development of Thief that Chey left Looking Glass, along with Ken Levine and Rob Fermier, to start Irrational Games.

A combination of frustration over a failed Star Trek game, some sales shenanigans with Terra Nova and British Open Championship Golf, and an admitted splash of presumptuousness, convinced the three that they could start their own company and make good on certain design philosophies they believed were important.

Ironically, Irrational's first game would be a co-operative venture with the founders' old home of Looking Glass.

'We were originally asked by Looking Glass to propose a science fiction shooter that used the Dark engine. It was our idea to try to latch onto the Shock universe and then it was just fortuitous that EA [Electronic Arts] saw fit to back it,' explains Chey.

'Ken Levine was the lead designer on Shock 2, but Rob Fermier and myself pitched in and contributed, as did pretty much everyone on the team. The original Shock was likewise created by a bunch of people, but Doug Church stands out as the "big brain", I think.'

Sadly, System Shock 2 would be one of the last games Looking Glass worked on. Shortly after Thief II hit the shelves in 2000, LG closed its doors and its IP was sold. Electronic Arts already had the rights to System Shock, but EIDOS bought Thief and since then, has released one game using the license.

'It was a very sad day for the industry,' notes Chey. 'On the other hand, I'm glad Irrational survived and picked up some of the pieces, as did ION Storm Austin ... at least 10 [Looking Glass employees are here] I think, though I haven't counted.'

Although innovative titles, Chey believes neither Thief nor System Shock 2 sold more than three or four hundred thousand copies.

'Respectable numbers, but not enough on their own to sustain the business,' says Chey. 'They had a string of critically acclaimed but commercially flat projects, all of which went over-budget and over-schedule.'

'It was a sad end for such a great company,' says Chey.

Ultimately, innovation was not enough to keep the company afloat, a fact that continues to be true today.

A kiss to Build a dream on

It's March 1993, and a young Ken Silverman is at his computer, fingers perched lovingly over the slick, beige plastic of his Key-tronic 101 keyboard. It's a normal day in East Greenwich, Rhode Island, but only if by 'normal' you mean 'crazy as hell' – one day it's raining, the next it not. Even the weather bureau has trouble predicting it.

But Ken doesn't care. It's time to program. And in March 1993, Ken began coding what was to become Build.

'I started researching Build soon after I released Epic's version of Ken's Labyrinth – which I think was right around the time id [Software] started hyping its initial specs about their upcoming Doom game ... I was 17,' says Silverman, now 28 and still living happily in Rhode Island.

'Build started like any project of mine. It was just another programming challenge that I would use to impress people.'

Silverman's website best proclaims his love for the coded word. 'For me, programming is not just an interest or a hobby – it IS my life,' it states in vibrant yellow Times New Roman. Dig deeper and you'll find more than 60 hand-coded programs are available for download, including the source to Build as well as Ken's Labyrinth.

'With Ken's Labyrinth [a basic Doom-clone] finished, and Epic offering me a deal I wasn't happy with, my dad convinced me to send a demo of Build to Apogee Software. I sent them a demo of Ken's Labyrinth a year before – and they responded warmly,' says Silverman.

In August of 1993, Silverman received a bug fix and feature request list for Ken's Labyrinth from George Broussard, Apogee's CEO and, later that month, Silverman signed a contract with Apogee to develop Build.

Build however wasn't the only thing Silverman had on his plate.

'During all this, I started my first semester at college. In order to make my parents happy, part of my contract with Apogee said that their work couldn't interfere with my education.'

Despite this, Silverman only passed two of his four courses that semester. He doesn't blame Apogee however for his lack of academic application. 'Soon after seeing my first report card, it became obvious to my parents where my interests [were]. So, they "allowed" me to work for Apogee full-time.

'Yeah, I know what you are thinking – I should have been making my own decisions. But I not that way. I have social issues,' admits Silverman.

ABOVE: Ken Silverman in his 'office' at home, and ION Storm's Tom Hall at E3. Silverman travelled all over the US while working with 3D Realms on Duke.

During his tenure working for Apogee, Silverman spent a considerable amount of time travelling between Rhode Island, Garland in Texas and Redmond in Washington. Silverman spent almost 300 days away from home, working on games based on Build including Duke Nukem 3D, Blood; a spooky horror title packed with zombie goodness; and Shadow Warrior, a game that cast the player in the role of 'ninja assassin' Lo Wang.

Although Silverman spread himself across a lot of 3D Realms' Build-powered titles, he spent a majority of his time on Duke Nukem 3D. 'I worked mostly with Todd Replogle [3D Realms programmer] and Allen Blum [level designer]. I have a lot of respect for those guys.

'Todd must have worked 20/7 programming for three years straight. Nobody questioned his work ethic. He was so optimistic; we knew he was lying half the time, but whatever he said – it worked, because it motivated everyone else to work harder.

'Allen was perhaps the most creative guy on the project. He did his work quietly. It was fun just to watch him use the Build editor. Many of the tricks you see in the game are to his credit,' says Silverman.

Silverman also spent some quality time with 3D Realms' chief George Broussard, staying at his home for the first few weeks of his run with Apogee while the company arranged somewhere for him to live.

'I probably ate more pizza and hamburgers during those two weeks than any other time in my life,' recalls Silverman.

However, things were not always so breezy. Silverman was approached a number of times by both Broussard and Scott Miller, 3D Realms' owner, regarding the lowering of his royalty rates.

'[It's something] I was not particularly pleased about. They asked because they wanted to give a share to all of the new people they had hired during the project,' says Silverman.

Another figure Silverman recalls was Duke's producer, Greg Malone.

'I could never figure out why they hired [him] ... I guess he was there to keep the artists busy, but to the programmers, he was just reminding us [of things] from his big "list" that we already knew about. George was the real producer/director throughout the project,' says Silverman.

Ken Silverman's career in the games industry came to an end in December of 1996, when, after spending almost three years away from university, he parted ways with Apogee and returned to studying. Duke Nukem went on to be the hit of 1996.

Asked if he had any regrets: '[They] would have to be those features I never had a chance to implement – and the fact the game couldn't be released sooner.'

Prey day

While work went on with Duke Nukem 3D, another project was bubbling under the surface at Apogee/3D Realms.

'In 1994, they asked me to start working on a next generation engine.... I called it "Polytex". I never got far with it though. It was just a generic BSP-renderer that displayed Build maps,' says Silverman.

3D Realms was chasing the next big thing – it just wasn't sure what that big thing was.

A number of developers during the period of 1994-1998 were working on next generation tech – id Software had Quake and Quake 2 and Epic had Unreal. Although 3D Realms was confident Duke Nukem 3D would blow the socks off the gaming community, the technology had roots in an era that was nearing extinction – the era of 2D.

Duke3D wasn't the only game 3D Realms was developing in 1994. The 'Developers of Immense Power' – Tom Hall, Jim Dose and William Scarboro, among others – as they were known at the time, were coming off the Wolfenstein 3D-based Doom-clone Rise of the Triad. ROTT originally started out as a sequel to Wolf3D, but somehow morphed into a trippy, action-packed shooter grounded in its own unique world.

Like most of the titles members of that team would go on to develop, ROTT suffered at the hands of poor timing, feature creep and backwards technology. The exception to this rule is Jim Dose, who now works at id Software.

'I didn't hang around with the ROTT team much,' says Silverman. 'They were in a separate office, and like the Blood team, had paranoia [in regards to] features being stolen from the other game. This was caused by the fact that team members profited only from the sales of their own game,' explains Silverman.

One such feature was one Silverman programmed himself – the ability to look up and down in Duke3D. A mere three days after it was coded it found its way into ROTT, and its team received the credit. It didn't take long before it appeared in other Doom-like games, long before Duke3D hit shelves.

With ROTT out of the way and idle hands as a result, work commenced on Prey in 1995 – its development headed by Tom Hall. Hall had previously worked at id on Doom, writing up the game's first design document.

In recent years Hall has dropped off the gaming radar, his last notable appearance being at ION Storm Dallas – the company he co-founded with John Romero – working on Daikatana and Anachronox.

Prey was to be a revolutionary title. Featuring a Native American captured by an alien species and enhanced with biological implants as the protagonist, players were required to master six combat disciplines in order to complete the game.

This concept however changed radically during Prey's development.

Tom Hall worked on Prey for a mere 12 months before leaving the company along with Jim Dose and a number of other DIPs in August of 1996.

The departure of such key players from Prey's team was the first indicator that something was not right at 3D Realms. It would serve as the starting point of the company's downward spiral into the airtight 3D Realms of today.

BELOW: Prey's second project lead, Paul Schuytema. Of all the leads, Schuytema was with the project the longest, working with 3D Realms for almost two years.

Paul Schuytema was brought in to replace Hall as Prey's project lead. At that point, Schuytema already had a firm grasp of games and game development, having written for numerous well known computer magazines and websites.

'I was with Prey for a touch over two years,' says Schuytema, who now resides at Magic Lantern Games, a games company he founded in 1998 after leaving 3D Realms. Posed with the question of what happened to Prey, Schuytema is honest about the problems he faced at 3D Realms.

'It's not all that complicated. One aspect is that we decided to move the 3D rendering from Glide to DirectX [having already moved from software to Glide]. That was a very hard decision to make, but in hindsight, it was absolutely the right one.

'During the transition, the game engine was in pieces for far too long – that, understandably made Scott [Miller] and George [Broussard] very nervous, since we still weren't 100 percent confident in the move to DirectX,' says Schuytema.

According to Schuytema, the technology was also not as robust or advanced as it needed to be. Consequently, this made the development of new and exciting elements a tricky proposition. In addition, 3D Realms was under pressure from publisher GT Interactive, who had suffered from the delayed release of Epic's Unreal, to get Duke Nukem Forever finished.

Direct ties

The Lithtech engine created by Monolith originally started its life as a collaborative project with Microsoft. With the introduction of DirectX back in 1995 came a need to take advantage of its features – what better a project to do this than a fully realised 3D FPS engine? So began 'DirectEngine', named obviously for its ties to DirectX, and Monolith started work on Riot, a Mechwarrior-like big robot FPS.

Development went on cheerily until April 1998, when out of the blue came a press release from Monolith, declaring the company had split from Microsoft. As part of the split, Monolith had bought the rights to not only Riot, but also DirectEngine – Monolith had basically spent big bucks to get a game and technology that technically, was its to begin with.

Perhaps to help wash away the bitter taste of the deal, Monolith renamed Riot to 'SHOGO Mobile Armor Division', and DirectEngine became 'Lithtech'. Work also began on the sequel to Monolith's Build-based Blood.

Was DirectEngine worth the hassle? The technology certainly sounded impressive at the time, incorporating features such as level of detail, mesh deformation, light mapping, colored dynamic lighting, and DirectMusic for 3D sound and dynamic music – technology we take for granted in games today.

Just recently, Monolith was acquired by Warner Bros. Interactive – just months after CEO Jason Hall left to join the division. Monolith is currently working on the Matrix MMORPG (Massively Multiplayer Online Role Playing Game).

Hardcore development on Prey continued throughout 1997-1998, and enough work was done on the title that it made a strong showing at E3 – albeit in the form of a non-interactive demo. This period was arguably the 'golden age' of Prey, when the project was at its most coherent. However, it was towards the end of 1998 that both Schuytema and William Scarboro – the last DIP working on the game – upped and left 3D Realms.

'Why did I leave? Quite simply, I was asked to,' says Schuytema. 'I was in charge of the game, and the game had some very real tech problems – like I was the coach of a football team. Sometimes the coach has to go.

'Again, with the hindsight of running my own company for nearly six years, I can see why they made the calls they did, and I respect them for that,' says Schuytema.

Schuytema has no bad feelings over working at 3D Realms or even what happened with Prey. In fact, he believes the company has a number of admirable qualities that encouraged creativity.

'I loved working at 3DR, though it was a little challenging with a wife and small child. It was an energised place with a great vibe, and everyone there cared passionately about games – I am truly indebted to both George and Scott for all they taught me during my time there,' says Schuytema.

'George has some sort of strange gene in his DNA that allows him to decode and deconstruct gameplay experiences like I've never seen before – and he did a great job decoding gameplay for the team so they could then build back up new and innovative game experiences.'

Sadly, William Scarboro, the other developer to leave Prey with Schuytema, died in August 2002 from an asthma attack. Along with Prey, Scarboro worked on Apogee's Rise of the Triad and Wacky Wheels.

'William was a great guy with talent to burn,' confides Schuytema, who developed a strong working relationship with Scarboro while he was at 3D Realms.

'He had these great quirks, like he was some character out of some crazy Farley Brothers movie. He always wore a black T-shirt (with a pocket) and jeans, listened to the most hardcore rap and hip-hop when doing math-intensive coding, and followed this odd diet that [had] him eating oil-soaked pasta one day and huge steaks the next.

'The programming community lost someone very special with William, that's for sure,' says Schuytema.

Corinne who?

With Schuytema gone, Prey was in need of a new project lead. Enter the mysterious figure of Corrinne Yu.

'We never met in person,' says Schuytema. 'Though we did correspond via email after she left 3DR as we tried to see if the tech she was developing was a match for some projects we were interested in – she's a very gifted programmer.'

Corrinne got her major break in the gaming industry at Zombie in 1995, where she was responsible for coding the original Special Ops engine. Before that, she worked at a company called Tachyon Studios as a lead programmer.

ABOVE: Corrinne Yu, the world's hottest game developer.

In 1997, ION Storm hired Corrinne as its Director of Advanced Technologies, where she worked with Tom Hall and John Romero on Anachronox and Daikatana. While there, a few sites caught up with her and managed to conduct interviews, including PlanetQuake (www.planetquake.com) and GameGirlz (www.gamegirlz.com).

According to a Tom Hall quote on GameGirlz website: '...she is a genius, producing code in minutes that astounds. At any point, she will be coding, running up the stairs, lecturing on the merits of Source Safe, running down the stairs, eating 10 plates of food, discussing quaternions, or watching anime. She's a fine, quirky Director of Advanced Technology, and a really interesting person to either talk to or be freaked out by.'

Perhaps the most intriguing part of Corrinne's work at ION Storm was her pet project 'Aidoru' – a 3D FPS engine that featured advanced technology far beyond that of competing titles, including Unreal and 'Trinity' – id's codename for what was to become, in some part, Quake 3.

Aidoru was to make use of true dynamic 3D lighting, 24-bit and 32-bit textures and procedural vertex and texture animation. A lot of these features found their way into Quake 2 code base ION Storm was using for Anachronox.

Then, in November 1998 came the news that Corrinne had left ION Storm and had been picked up by 3D Realms to work as lead programmer on the company's next-generation engine. The name Aidoru disappeared, and to this day little is known about Corrinne's reasons for leaving ION Storm. What is most likely is

Hook, line and sinker

In the midst of all this development and innovation, there was 3D acceleration. 3D has grown up alongside the FPS and has been pivotal in providing the genre with a number of revolutions including volumetric shadowing, pixel shaders and high-dynamic range lighting.

Up until 1998, there were three graphic APIs (Application Programming Interfaces) – DirectX, OpenGL and Glide. It was in 1998 that the future of Glide was decided.

'DirectX and OpenGL in particular were gaining significant traction, and 3dfx was in pretty significant denial about the long-term viability of Glide,' says Brian Hook, one of the pioneers of 3dfx' graphics API. Hook has worked for a number of companies, including 3dfx, id – where he helped to program Quake 2 and 3 – and his own business, Pyrogon Software.

'Glide was positioned there [at 3dfx] as a "competitive advantage", which was very true in the 1995-1997 time frame, but once 3D APIs began to mature, it really didn't have much of a reason to continue on.'

According to Hook, the Glide API wasn't that advanced, and was considerably inferior to OpenGL. 'Glide was a practical concession, in the short term, to get a decent API [into] the hands of developers. By "decent" it meant that a lot of the higher level stuff had to be deferred to game developers who would have been too constrained by OpenGL's pipeline,' says Hook.

'Compared to Direct3D, I think Glide was significantly better just from a usability standpoint, which is one of the reasons why Glide managed to survive so long.'

'I thought it did a terrific job for what it actually needed to do during a time when really no one in the PC space comprehended what 3D acceleration was all about. But by 1999 Glide was completely irrelevant.'

In 1996, Hook left 3dfx, in dismay over the company's direction. 'I left because I had pretty much lost faith that they had any idea what they were doing.

'A little known fact is that 3dfx was originally created for the coin-op industry – moving their products down into the PC space was going to be gravy, milking the enthusiasts for the privilege of – get this – playing arcade games with full fidelity at home,' reveals Hook.

'That was not how it played out, for many different reasons.'

In 2000, 3dfx declared bankruptcy and was quickly snapped up by NVIDIA. Today, Glide and ancient Voodoo cards are the company's only legacy.

ABOVE: The Xngine-powered Future Shock and Daggerfall are Bethesda's best remembered games. Daggerfall sacrificed stability for depth, but this mattered little to those who loved the game.

that she was frustrated over the craziness that was Daikatana and concerned about the company's future. Indeed, ION Storm Dallas closed its doors in 2001.

Shortly after joining 3D Realms, Corrinne was appointed the position of project lead on Prey, and seemed an appropriate choice considering her experience working on the Quake source, as well as her own knowledge of creating engines from scratch.

Unfortunately, for both Corrinne and 3D Realms, neither Prey nor her career in the games industry were meant to be. Sometime early 2000, 3D Realms stopped pimping Prey on its website, Corrinne left the company and 3D Realms dreams of making their own engine evaporated. The focus was shifted onto Duke Nukem Forever, where it has stayed for the last four years.

No one knows where Corrinne is now – the only traces left of her are some old game site interviews, posts on 3D graphics Yahoo groups and few Slashdot entries. Nothing however is dated beyond 2001.

Daggerfall into the void

Blue Sky and Apogee weren't the only companies innovating 3D back in the 90s. Bethesda Softworks, today known for its award-winning Morrowind series, was busy crafting Xngine, its own gift to the world of FPS.

Developed in two years by Danes Kaare Siesing and Morten Moerup, Xngine featured true 3D and phong lighting, both of which were considerable feats way back in 1995, when Quake was still in development.

The first game to use Xngine was Terminator: Future Shock. Perhaps not often remembered for its contribution to 3D, Future Shock is heralded as the game that brought us the now-ubiquitous mouse-look.

'That was me,' says Todd Howard, producer for Future Shock. More recently, Howard was the project lead on Morrowind, and is the executive producer on Fallout 3.

'Kaare made a similar interface for the editor that we built levels in, and I tweaked the interface so we could use the mouse in-game and everyone here loved it. I will say that the press at the time didn't take to the mouse-look at first – they really wanted a Doom-style keyboard config.'

Another Bethesda title, Daggerfall, was also developed around the time of Future Shock. It too made use of Xngine, and is perhaps the best remembered of Bethesda earlier titles. According to Howard, Daggerfall's main strength, and biggest downfall, was its immense scope. At any given time, the team consisted of around 10 people, working as a collective. This number would be ramped up to about 20 towards the final stages of production.

Howard believes the size of the team was about right. However, he does admit that, thanks to the game's almost insurmountable depth, Daggerfall unfortunately shipped as a less than stable product.

'In hindsight, yes. [It was] very buggy. We simply didn't test it enough on different hardware. It worked great on our machines here, but out in the market, it had "issues".'

'[But] people love open ended games, even if they have bugs. If they didn't have bugs, even more people would love them.'

When it's done

First person shooters have defined gaming as it is today in incalculable ways – from technology to businesses to people, it has had a wide-bearing influence – one that has been as much positive as it has negative.

'The industry today is very much big business,' says Hook. 'Games cost more, are much broader in scope, have to support consoles a lot more, and are managed (or at least should be managed) more like assembly lines.

'Even five years ago I think every person on a team could have a concrete contribution to a project. Today there are far more cogs-in-the-machine, so an artist or a programmer today can only affect a tiny portion of the overall.

'It's the difference between a musician and an orchestra and a rock band. In the rock band you can make a statement – in an orchestra you basically just try not to fuck up and make everyone else sound bad.'

Irrational's Chey agrees. '[The industry] continues to get more professional as the amount of money being made and the cash being spent goes up.

'Unfortunately, this does not correspond to an increase in the amount of innovation in the industry – in fact, probably the opposite,' says Chey.

The opinion that the modern games industry is driven by dollars is universal. Games are made because they will sell, rather than being new or innovative.

'The high cost of development is unfortunate, as it makes risk taking harder and encourages "do what you know" behaviour, and players reinforce that by buying the same way,' says Church.

In the end, it's up to the developer if it wants to try to innovate, or just make money. Usually, the decision is made on the basis of whether it can afford to make a dud.

'Games are made by people, and ultimately a great game comes from getting a group of people together who like each other and want [together] to do something special,' says Chey.

'If you can't make that happen, you can forget your chances of anything really good coming out it all.'

Ashton Mills, Atomic #30

The Uber-Linux box project Pt5

Penguins starting to looking attractive? Finding those slippery curves alluring – in a half-bird, half-fish monstrosity kind of way? Ashton Mills teaches us to tame and court Linux's inner bandwidth.

This month we have more sexy Linux goodness for you. It's so sexy, in fact, that it's uber sexy. What could we possibly add to your connection and file sharing, firewalling, ad-blocking, stat-graphing and game-serving uber box of joy?

First, some theory.

The shape of things

Even though your pipe to the Net may be a 128Kb/s, 256Kb/s, 512Kb/s or higher, your cable or ADSL modem is capable of more. How an ISP distributes bandwidth among its users, enforces upload speeds, and does nifty tricks like reducing your download rate when you breach your monthly cap is through some networking magic that goes by the name of 'bandwidth shaping'.

Now, normally only routers do this sort of thing. But Linux, bless it, can also act as a router. Why would you want to shape traffic on your Linux box? Well what if, for example, you shaped traffic based on protocols or ports? Say, to prioritise one type of traffic over another? Such as the type of traffic that games use? Have you ever wanted to:

- Play games online while a big download is going, but found it too jerky to play?
- Browse the Web with speed, even while your P2P software is leeching in overdrive?
- Prevent flat mates or siblings impinging on *your* vital bandwidth when you're downloading or playing online?
- Be loved and adored by everyone, everywhere?

Well now you can, and the Uber Linux Box Part 5 will show you how.

The power of packets

When you get down to it, playing with packets is fun. You can shape bandwidth on all sorts of criteria, from the protocol (such as TCP and UDP) and destination or source IP address, through to ports and even the size of a packet. If you can think of it, you can do it.

As *Atomic*, we're going to focus on some of our passions – games, file sharing, and browsing. We've built a special *Atomic* Uber Shaping (AUS) script for this very purpose to complement the Uber Linux box, and to help you master the art of playing packets. Use it wisely, for its power is great.

Why your bandwidth isn't

The golden rule to remember when it comes to bandwidth shaping is that you can only shape what you *send*. You can't control what the world sends to you. Even so, in true *Atomic* style, we'll find a way around this a little later.

So here's the deal: in the interest of providing you fast downloads your ISP uses a very large buffer for sending data

WHAT YOU NEED:

1 A box

The first four parts of the Uber Linux box guide can be found in *issues 20* to *23*, so if you don't already have an uber box up and running now would be a good time to start.

Note that while the Uber Linux box guide is based on Mandrake 8.2, you can use it on any distribution. All you need if you want to follow the guide is Samba for Windows file sharing, iptables for the *Atomic* firewall to share your connection and protect your network, Squid to speed up browsing and save on bandwidth, and Apache and mrtg to graph your throughput using the *Atomic* monthlystats script. All of these packages are readily available in most distributions. I have it all running under Gentoo.

This tutorial also can be applied to any box. You just need to install the iproute2 package, which if you're following on from the previous Uber Linux box tutorial should already be installed. If it isn't, **rpm -ivh** the package from install CDs.

2 A kernel

Additionally, whichever distribution you use, you're going to need a 2.4.20 or later kernel. To see which kernel version you are running, login and type: **uname -r**. If you're using the same kernel you installed with Mandrake 8.2, you're going to need to upgrade – so if you so far haven't compiled your own kernel before, now is as good a time as any (and besides, it's a great party trick!).

Grab the latest stable kernel from ftp://ftp.kernel.org/pub/linux/kernel/v2.4 – named at time of writing 'linux-2.4.20.tar.gz'. If you haven't compiled your own kernel before just follow the 'Roll your own kernel' guide in part 4 (*issue 23, page 102*), and pay attention at the end where it mentions installing source from a .tar.gz.

When you're configuring remember to include all the drivers and features you need (**cat /proc/pci** is your friend). Take it slowly, and if you're not sure about something, compile it as a module. Additionally, in order to use gateway/firewalling and bandwidth shaping capabilities, enable the following:

- Under Networking options -> IP Netfilter configuration: compile everything as a module.
- Under Networking options -> QoS and/or fair queuing: compile everything as a module, with the exception of 'Special RSVP classifier for IPv6'.

Don't be concerned if your first kernel build fails to load. It's a huge learning curve for any level of geek. Just look at the error, figure out what you need, and remake it. Once you're confident it works fine you can make it your default boot in lilo. And don't forget Google and forums if you need help – there's plenty of people who know kernel compiling like the back of their pasty hand.

3 The traffic controller

You *may* need an updated version of the TC (traffic control) program. Your distribution might already include this, but there's no harm in being sure (you may get errors later on otherwise. Which is kind of bad).

Grab http://luxik.cdi.cz/~devik/qos/htb/v3/htb3.6-020525.tgz, decompress it in /tmp, and copy 'tc' to /sbin.

4 The *Atomic* Gateway Kit

Head to www.atomicmpc.com/downloads and grab 'atomic-kit.tar.gz'. This includes not only the AUS script but also updated versions of the *Atomic* firewall and monthlystats. Read the README for a list of changes to the programs.

Decompress the archive and copy both 'atomic.firewall' and 'atomic.shaper' to /etc, editing atomic.firewall first to suit your network (remember to uncomment HTTP forwarding if you're using Squid) and move across any changes you made to your current version.

Run /etc/atomic.firewall and make sure everything is working as before.

When you've done these steps, you're ready to proceed.

down the line to you. Your cable or ADSL modem, also, has a large buffer to help maximise upstream throughput.

However these buffers, known as queues, become problematic when it comes to interactive applications. If you set off a download and then try and use your link for anything that requires fast response times, such as online gaming, these queues – filled by the fast download – will cause massive delays while packets wait in line. For the download, this doesn't matter. For realtime applications, this is a killer. Responsiveness drops through the floor, and what was a 50ms round-trip becomes 350ms and littered with burst spikes.

So how do we shape bandwidth to prevent this from happening? The first step is to move these queues from the ISP and modem to your Linux box where you have control. Once they reside safely on the Linux box, you can do whatever you like with them.

Doing this is actually quite simple – set bandwidth caps on the Ethernet card connected to your cable or ADSL modem that are *just* under the maximum bandwidth of your link, and the queues in the modem and at the ISP disappear. The rate of flow will no longer be higher than the rate of your bandwidth, and so the queues no longer fill up. Then it's just a matter of making your own queues on the Linux box and re-ordering packets to suit your needs.

Didn't I say this was going to be sexy?

Right on queue

Before we begin, let me introduce you to some queues you didn't know you had. Telnet or SSH into your box and run: **ip link list**.

Every Ethernet device comes with a default queue that, in routing parlance, is known as a queuing discipline, or 'qdisc'. You'll see that the default qdisc is 'pfifo_fast', otherwise known as the 'priority band first-in first-out (FIFO) queuing discipline'. We'll get into priority bands a little later, but in short the pfifo_fast qdisc recognises and respects TOS (Type Of Service) bits attached to packets. TOS bits include settings such as 'minimise delay', 'maximise throughput', and 'maximise reliability' and can be set by network aware programs. For example, SSH under Linux automatically marks packets as 'minimise delay' so that any router along the way (such as your Linux box) will prioritise these packets above all others, even in the simple FIFO queue.

Your Linux box has already been maximising the efficiency of your connection!

The problem with this queue, however, is that it's very straightforward and we can't play with it. If we're going to shape, we need to replace it with something more versatile.

So how do we replace this simple qdisc with one of our own design?

The flow tree

Before we install a new qdisc it helps to map out what we want to achieve.

There are two other parts to the qdisc equation – 'classes' and 'filters'. Think of classes as qdiscs that represent different types of data you want to classify, and filters as the selection criteria that physically grabs the packets and puts them into the right class ready for sending.

Every device must have at least one qdisc, the 'root' qdisc. To this can be attached multiple qdiscs which can be standalone or act as parents from which further qdiscs can be attached. This way you can separate and sub-divide your bandwidth into any sort of hierarchy.

For our requirements we want to shape bandwidth into three classes: gaming traffic as top priority, followed by Web (for browsing) and other interactive traffic (like SSH), and lastly a bulk class for everything else. We also need to attach these to a 'parent' qdisc that can be used to 'group' the three classes together, enabling the sharing and management of bandwidth across them all.

You can see how this works in figure #1.

Linux provides us with a variety of qdiscs and filters we can use to accomplish our task, so lets look at what we need.

Queuing disciplines

Qdiscs come in two forms – classful and *classless*.

- **Classful** qdiscs are those which can themselves support other classes (sometimes called bands) and include CBQ (Class-Based Queuing), HTB (Hierarchical Token Bucket) and PRIO (Priority band).

  CBQ and HTB are both capable of shaping bandwidth across multiple classes with priority and rate limiting. PRIO, by comparison, is more like a souped-up pfifo_fast qdisc and while it can prioritise bandwidth among classes, it can't really throttle them. PRIO is particularly useful when all you are after is simple priority management.
- **Classless** qdiscs are, as the name suggests, unable to support child classes and often form the end point (leaves) of your flow tree. Classless qdiscs include the default pfifo_fast, TBF (Token Bucket Filter) and SFQ (Stochastic Fairness Queuing). TBF is a basic FIFO queue that has the extra ability of being able to rate limit much like CBQ and HTB. If all you want to do is slow down a link, TBF is ideal.

  SFQ is unique in that it doesn't prioritise and can't throttle bandwidth, but instead provides the ability to (stochastically) balance all data streams passing through it. In other words, if you had five programs all sending data at once, SFQ will do its best to ensure each stream gets equal opportunity to send – this is different from a FIFO queue which is, as you'll remember, first-in first-out.

  There is also one more classless qdisc which is even more basic than pfifo_fast – it's the simple *pfifo*. Unlike its cousin, pfifo can't prioritise, it's just a plain FIFO queue measured in packets. It bears mentioning here because we'll be making use of it.

Filters

As mentioned earlier filters are used to selectively place packets into their appropriate class, and there are a variety of filters you can use. These include filtering based on routing tables (the 'route' filter), packets marked by a firewall with iptables (the 'fw' filter), and a special filter (called 'u32') that allows you to classify packets based on source and destination addresses, source and destination ports, protocols, and even packet size.

More information about these qdiscs and filters and their associated settings can be found in the Advanced Routing & Traffic Control HOW TO at www.lartc.org.

Shaping, Atomican style

If you've stuck with me this far, you're a hero. Now lets take a look at the AUS script to see what we use and why.

Remember the goal is to shape in such a way that we can set off downloads or leave P2P software running in the background without it having a major impact on online gaming, Web browsing, and other realtime tasks.

To do this we could use a combination of a PRIO parent qdisc with three child TBF qdiscs – PRIO would provide the priority we need, while TBF would allow us to rate limit the link to ensure the queue resides on the Linux box. And in fact if you can't upgrade your kernel, this is exactly what you can do (since PRIO and TBF are part of the whole 2.4 kernel tree).

However this combination isn't very efficient – being classless, TBF can only act independently. In order to keep control of the queue the total of the rate limits of all TBF classes cannot exceed the capability of your link. This would mean each class can only go as fast as its portioned limit, even if there is unused bandwidth available from other classes.

Enter CBQ and HTB. Both of these classful qdiscs allow for the sharing of unused bandwidth of one class with that of another. This translates to being able to use the full bandwidth of your link while still prioritising traffic. We like this. Between the two HTB is easier to use than CQB and slightly more efficient, and so it's our qdisc of choice.

In addition to using HTB for parent and child classes, we also attach a speedy pfifo qdisc to our gaming class to provide minimal latency, and an SFQ qdisc to each of our high priority and bulk classes to maximise their efficiency.

Shaping upstream

Open up /etc/atomic.shaper in your favourite text editor and scroll down to the section beginning with 'EGRESS'. This is where we set the shaping rules using the traffic control (tc) tool that lets us manipulate qdiscs and filters. The rules can be broken down into the respective sections from our diagram:

- **Root qdisc:** The first command replaces the default pfifo_fast with our HTB qdisc. The 'handle' is an identifier by which we can reference the qdisc, and 'default' the default queue any unclassified traffic should be sent. The '30' is a class identifier we have yet to create.
- **Parent qdisc:** The next line creates the parent HTB qdisc to which we will attach our three classes, and here we set the global rate to throttle the device. The 'parent' value refers to

the handle of the root qdisc. The 'classid', like handle, allows us to reference the qdisc so we can attach child qdiscs.

- **Child qdiscs:** The next three lines create three HTB classes of lowering priority (numbered 1 to 3). Here's where we do our real shaping.

Firstly note each class has its own 'rate', together totalling no more than the rate of the parent. The rate represents the desired guaranteed speed for a class if the link were saturated. At other times each class can reach up to its specified ceiling by borrowing unused bandwidth from other classes.

These are important values. You'll see that we give our gaming class half the link, even though most games won't use that much. What's important is that if they needed to, then it would be there for them. The rest of the time any unused portion is automatically assigned to other classes by the parent.

The ceiling is also important. Normally you want this to equal the parent qdisc ceiling, but in the AUS we cap our bulk class to about 60% of the link.

While HTB does a great job shuffling the bandwidth around, it can't guarantee an uninterruptible stream. Setting a limit on the bulk class provides room for the gaming class to run uninterrupted while uploads are in progress.

For the same reason we also specify low burst rates for our bulk class. Bursts are the maximum amount of information that can be sent in one go. High bursts equal good transfer speeds, but can cause 'spikes' in throughput of the qdisc.

By setting low burst values for the bulk class we minimise the impact of these spikes. You can halve the 1Kb value if you wish to create an even smoother stream, with only a minor reduction in upload speed.

It's worth noting that for all but online FPS games, HTB's default allocation and burst rates work just fine. The above tweaks are specifically to support smoother gaming in FPSes where a clean stream is vital. Additionally, these tweaks are mostly to provide clean *download* streams. See the sidebox 'The law of ACKs' to understand why.

Lastly, you'll note our bulk class is given a 'classid' of 30, the default class referenced by our root qdisc at the beginning.

- **Leaf qdiscs:** Though not shown on the diagram, we attach qdiscs to maximise the efficiency of each class – a clean, fast pfifo for our gaming class, and two SFQ qdiscs for high priority and bulk for the multiple streams they will handle.
- **Filters:** All that remains is to add the filters that classify packets. We do this in the *Atomic* firewall as its easy and keeps all packet manipulation in the one script, but we still need to look out for the marked packets by using the 'fw' filter.

And that, essentially, is our shaping script. Now open up /etc/atomic.firewall and scroll down to the 'BANDWIDTH SHAPING' section.

Each iptables command checks to see if a packet matches our criteria and allocates it to the correct class – gaming (10) or interactive (20) – by mangling (modifying) the packet. In this case, a mark is added that will be recognised by the 'fw' filters. Anything not marked is captured by the 'default' ruling of the root qdisc and sent to bulk (30). The numbers are arbitrary, as long as the values used here line up with the values for the filters in the shaping script.

As most games use UDP these packets are marked for class 10, as are any packets travelling to DirectPlay ports. This should cover most games. We also prioritise TOS marked and SSH packets to class 10. Web, ACKs and other high priority traffic are marked for class 20.

Beneath this are companion rules for traffic we want to prioritise on the downstream. These must only be for class 10 traffic.

Note if you ever want to add a new port, protocol or IP address for shaping you can do it just by creating another rule and marking packets accordingly. If you have a new game or program and you don't know which port or protocol it uses, start it up, open a command prompt in Windows and type: **netstat -a**. Look for the connection your machine has initiated, note the protocol and port, and add these to atomic.firewall. To see which rules are in effect, run: **iptables -t mangle -L**.

Shaping downstream

All of what we've covered so far applies just to outgoing traffic. What about incoming?

The same rule holds true for moving the queue to the Linux box – we throttle the link. This is well and good, but what about prioritising traffic? The short answer is you can't, not directly anyway – remember you can only shape what you *send.*

However we can fudge this a little, and for this we rely on the nature of TCP/IP and some tricky filtering.

As a self-regulating protocol TCP/IP will automatically reduce its speed if packets start to go missing. It'll lower the rate until it finds a sweet spot, and then do its best to push the limit when it can. By simply dropping packets we can reduce the rate until its below that of your connection, thereby emptying the ISP's queue. This makes a huge difference to responsiveness on a saturated link. Even with a full speed download in progress, throttling allows packets to arrive as fast as they can, as they're no longer caught up in a queue.

We do this by using the ingress qdisc. Open up /etc/atomic.shaper again and scroll down to the 'INGRESS' section. You can see the tc command that attaches the ingress qdisc, followed by a command to attach a special police filter – this filter quite literally polices the link, dropping anything coming in faster than the specified rate.

Note that while we can't shape what comes in, we can selectively police packets. You'll see the filter only picks up packets marked as bulk – our high priority classes will come right though unhindered. This is ideal, as dropping these packets will cause slight bumps in the streams. However it also means that the combined speeds of these packets plus the bulk class must not exceed the speed of your link, or the queues at the ISP will fill again. This is why it's important to properly tune your throttling rates, which is what we will take a look at next.

Setting the rates

At the top of the AUS script you can set the Ethernet device, the downstream and upstream values, and the downstream burst rate.

Start by setting the 'UPSTREAM' and 'DOWNSTREAM' in kilobits to around 20% less than the advertised speed of your ▷

link. Don't worry, shaping works off real throughput, so putting in a value 20% less may in fact still be exceeding your link, and thus not throttling it. Cable users have much more headroom available here than ADSL users.

For example, I have 512/128Kb/s ADSL connection. Theoretically my maximum download speed is 64Kb/s (bits to bytes, 512 divided by 8), but in reality due to TCP/IP overheads, PPPoE overheads, and other ethereal influences, I normally only get about 54Kb/s maximum. This translates to 430Kb. Sure enough if I set my 'DOWNSTREAM' to 450, for example, my link doesn't get throttled. At 420, it does.

Find a place where you know you can download a large file at full speed. Start the download, run **/etc/atomic.shaper**, and then run it again with the status switch: **/etc/atomic.shaper status**. Run it every couple of seconds and watch for dropped packets where it says 'qdisc ingress'. If packets aren't being dropped, lower your 'DOWNSTREAM' value, re-run the script and check again.

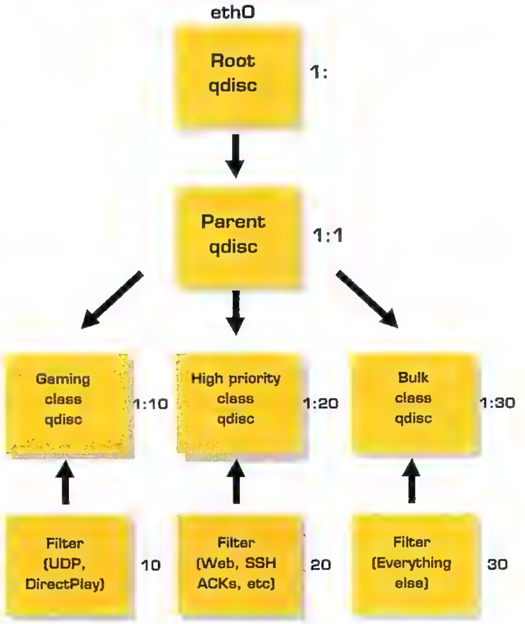


Figure #1: **A basic flow tree for the AUS. Technically the filters are actually attached to the root qdisc, but feed into our three classes.**

Repeat this process until you start to see packets being slowly dropped. If packets are being dropped at about one a second you've hit the perfect level. If they're being dropped rapidly, raise your limit up. Remember the idea is to move the queue to the Linux box while still making maximum use of your connection bandwidth.

Now knock 20Kb off this value. This is to leave room for the class 10 high priority traffic we don't police on the ingress (if we don't make room for it, the ISP queue will fill, causing those unwanted delays).

Ultimately you lose some of your maximum download bandwidth by doing this – however being able to download at 90% of your link speed while playing games is far better than not being able to download at all!

For 'UPSTREAM' stick with the 20% estimation. It's not so important you max out your upstream, but it's *very* important that it's low enough for you to control the queue (again see 'The law of ACKs' sidebox).

As an example, for my 512/128Kb/s ADSL connection I use 390/100 for my downstream/upstream.

Tuning the rates

Now try setting off a full speed download and play an online game. Half Life is an excellent indicator as its very sensitive to realtime streams and you can enable the netgraph to see the streams with 'net_graph 1' in the console.

If the downstream is laggy and creeps up slowly, you're witnessing the queue filling up at the ISP and packets are getting delayed. Lower your DOWNSTREAM.

If the downstream is excessively spikey you can try changing the downstream BURST value. As with our bulk class, burst has a huge impact on the smoothness of a stream. I've set a default 32Kb (4KB) which should work just fine for most situations, but for a more refined stream try lowering it to 24Kb (3KB) or even 16Kb (2KB). Note you'll reduce your maximum download speed somewhat.

If your downstream is spikey while only uploads are going (say from P2P software) lower your UPSTREAM value.

After using the shaper for a while a healthy status output might look something like this:

```
qdisc ingress ffff:
  Sent 161745752 bytes 202476 pkts (dropped 3651, overlimits 0)
qdisc sfq 30: quantum 1514b perturb 10sec
  Sent 46676298 bytes 32719 pkts (dropped 0, overlimits 0)
qdisc sfq 20: quantum 1514b perturb 10sec
  Sent 5049381 bytes 85239 pkts (dropped 0, overlimits 0)
qdisc pfifo 10: limit 25p
  Sent 6635083 bytes 74698 pkts (dropped 0, overlimits 0)
qdisc htb 1: r2q 2 default 30 direct_packets_stat 0
  Sent 58360762 bytes 192656 pkts (dropped 0, overlimits 174530)
```

We can see our qdiscs, dropped packets on the ingress, and overlimits caused by our rate limited bulk class doing its job. Hurrah!

Conclusion

Once you've balanced the rates put /etc/atomic.shaper in your startup scripts and enjoy. You'll find you can browse smoothly and play games even while P2P software and downloads are going full ball.

After a while you even forget there was a time when you had to cancel your downloads and close Kazaa just so you could play some Natural Selection or Battlefield 1942. They will be times you can scratch out of your mental diary with a smile plastered on your face.

Congratulations on completing part 5, and making your box even more uber than it already is! ▢

THE LAW OF ACKS:

Normally a download consists of data laden packets coming down the line, and ACKs going up.
ACK packets are small 'acknowlegement' responses TCP/IP sends to confirm the receipt of a packet. If ACKs don't arrive at the sender, the sender resends the packet that didn't make it.
Saturated upstreams, and thus delayed ACKs, will cause the downstream to suffer even if the downstream is under-utilised. This especially holds true for games, even using UDP.
This is why we cap the bulk class, set low burst rates, and prioritise ACKs in the high priority class, leading to clean and fast downstreams. Additionally, downloads will be faster, especially in P2P software while uploading. As an aside you should limit P2P software to two concurrent uploads and downloads to prevent overheads impacting performance.

editorial

Ben Mansill, Atomic #2

Graphics 2D For

Six years ago I attended the launch of a new video card from Diamond. My colleagues and I wondered, while scoffing juice and cake before the show, whether the 'Diamond Edge' would be the card to knock the Tseng Labs ET4000 off as King of Cards. We all used the ET4000, wonderful card it was, SVGA was actually feasible, sort of... Could it get any better? Oh yeah... and how!

When the friendly American Diamond guy fired up the Edge, straight after talking a bit about some new company called 'NVIDIA' which had provided the Edge's chip (sensibly named the 'NV1'), we saw the familiar site of the Best of Sega Saturn. See, the big deal with the Edge was that it ran ported Sega Saturn games. It also had a special input for Saturn control pads. But that's all it did. There were only ever three or four games released for Edge, all Saturn ports and it was hell expensive.

Back then we were in the midst of Saturn worship, at that time typically playing a solid couple of hours of Virtua Fighter every night. As a result, our collective industry response was underwhelming. We all had Saturns anyway, and just couldn't see the point. Winner: ET4000. Big joke: 3D acceleration.

Ironically, this early developing situation was one of upstart NVIDIA trying to ride the success of Sega's hardware. How things change...

How they change for the better! The intervening years saw 3D acceleration rise as the most significant paradigm leap PC gaming has yet experienced. It took a while though, and there was surprising reluctance from the industry to adopt this new, obviously superior technology. A big shout out here to John Carmack, who was arguably responsible for the uptake of these cards. While much of Carmack's motive to support Voodoo Graphics was its excellent support for Carmack's preferred API OpenGL. His game; Quake, was just too compelling in hardware mode to ignore. But ignored it was, by the retailers. This held up progress for about a year, as major retailers – including the largest and most prominent game specialists in Australia, refused to carry the cards. Only when the numbers of desperate customers overwhelmed them did they take it seriously.

And the rest, as they say, is history. It's a fascinating story. Read all about it, as they also say, in our feature story this month. Great work from John. We'd like to thank Nick at Creative for his help getting chipset release dates right.

We may be a young industry, but our history is deep and detailed.

Ben Mansill, Editor

The Men of Atomic in the Labs, L to R: Ashok Zaman Bennett Ring, John Gillooly, Ben Mansill, Tim Dean, David Hollingworth

The boys in the midst of a heavy benchtesting frenzy

atomic

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Dan Rutter, Atomic #68

The embarrassingly easy case mod

Daniel Rutter is full of bright ideas.

The problem with basic electronics projects is that they have a very bad 'effort to result' ratio.

OK, you have to learn to solder somehow, but the niftiest thing you're likely to end up with after working your way through the whole *Let's Learn About Wires* kit series is a weeny FM transmitter.

So here, for your delectation, is a *Things You Can Make* that's easier than that very first two-LED flasher kit, and creates a genuinely cool (though not, I grant you, especially useful) effect.

You've probably seen little LED lights of various kinds that cycle through red, green and blue, and then numerous psychedelic combinations of those colours. They're popping up all over the place – in those twinkly mobile phone antennas, in novelty key-ring flashlights, as decorations for the burgeoning sector of Random Things That Run From USB Power Products, and so on.

In the olden days, the only way to create this sort of effect was with three separate lamps and a control box of some kind.

> "In the olden days, the only way to produce this sort of effect was with three separate lamps and a control box of some kind."

Then along came low brightness multi-lead LEDs that combined two or three different coloured dies in one normal 5mm package, but still needed outboard driver hardware.

Then there were high brightness versions, just one of which could deliver pen light brightness.

And now we have simple two-lead LEDs with three dies and control hardware, packed into a minuscule chip inside the standard-sized LED itself.

These RGB LEDs don't let you control their colour or cycle rate – they just loop endlessly through their fixed sequence of colours. You can get fast-change, slow-change and flash-flash-flash versions, but you can't turn one into another. And they don't project their three pools of light on top of each other – you get three separate circles of light.

Furthermore, no two of these LEDs will cycle at exactly the same frequency, so you can't make a synchronised array of them. A significant percentage of them have their own odd opinion about what colours to show.

All of this can be forgiven, though, because a bag of fifty slow-change LEDs on eBay ought to cost you no more than $20 delivered.

And, importantly, they don't even need a series resistor. Normal LEDs pass more current when they get warm, which makes them warmer, which causes them to pass more current, and soon you have what's known to us professionals as a 'friode'. You need some kind of current limiter to stop that from happening. But the controller chip in an RGB auto-LED does that for you. All you need to do is feed the LED the right voltage.

'The right voltage', I'm happy to say, is about three volts. You need at least 2.8V for all three dies to light at reasonable brightness – from 2V, only the red die will light – and they'll be brighter from about 3.7 volts. But 3V works, and is very convenient.

You have a lovely high current 12V rail inside your PC. You can thus connect these LEDs together in strings of four (the long leg of each LED is the positive terminal) and run them straight from +12V (that's the yellow wires, kids). Each string will only consume an average of about 15mA, so you can run pretty much as many of them in parallel as you like without straining a PC PSU.

Presto – instant disco fever case mod.

You can get multiple-of-three voltages from lots of other things, too – any even number of ordinary 1.5V batteries in series, for a start. Retro-fit that old torch!

A string of five NiMH or NiCd cells gives 6V; now there's a use for those dusty model car batteries with one dead cell.

Repurpose old plugpacks to run a string of RGB Christmas lights!

So there you go, electronics noobs. At long last, your first step into the world of basic circuits can be groovy.

Electricity has done wonderful things to Dan's hair.

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John Gillooly, Atomic #10

FrisbeeMark™

During the rare quiet moments in the Atomic Labs, time is usually devoted to coming up with innovative new benchmarking methods in order to objectively measure the immeasurable. Besides our pioneering SolitaireMark TM system benchmark, TouchyFeelyMarkTM mousepad benchmark and the ever popular StenchMarkTM method of evaluating new hardware (based on the new car smell concept, but aimed at circuit boards) we have come up with a host of less successful methods that were subsequently discarded after intense testing.

The latest benchmark we want to announce is the creation of FrisbeeMarkTM. This exciting new concept comes as a result of dealing with yet another motherboard that wouldn't boot up. Reports differ on who actually said it, but the bloodcurdling cry of 'I trust this board about as far as I could throw it' was heard to echo throughout the Labs.

Rather than feel dejected, however, we saw this as a great opportunity for new benchmarking procedures. One of the hardest things to get a scientific grip on is reliability. Enter FrisbeeMarkTM, which puts into practice that age-old cliché of trusting something as far as you can throw it.

The scene for testing was the vacant lot situated behind the Atomic Labs. The necessary gear comprised the products to be tested, an electronic Theodolite (those things worth several thousand dollars that surveyors leave sitting unattended at the side of roads), eye protection (circuit boards can have sharp corners), a windsock, radio for contact with air traffic control (we were optimistic) and a case of beer (we *are* only human).

Our tests were conducted using several items of hardware. Ranging in size and weight, the selection included heatsinks, motherboards, TFT monitors and several ATX cases. Each item was thrown three times, and the results were then averaged and adjusted for wind assistance. To minimize experimental error, the sober member of our team, Chris (aka TBA), the work experience guy, conducted all throws.

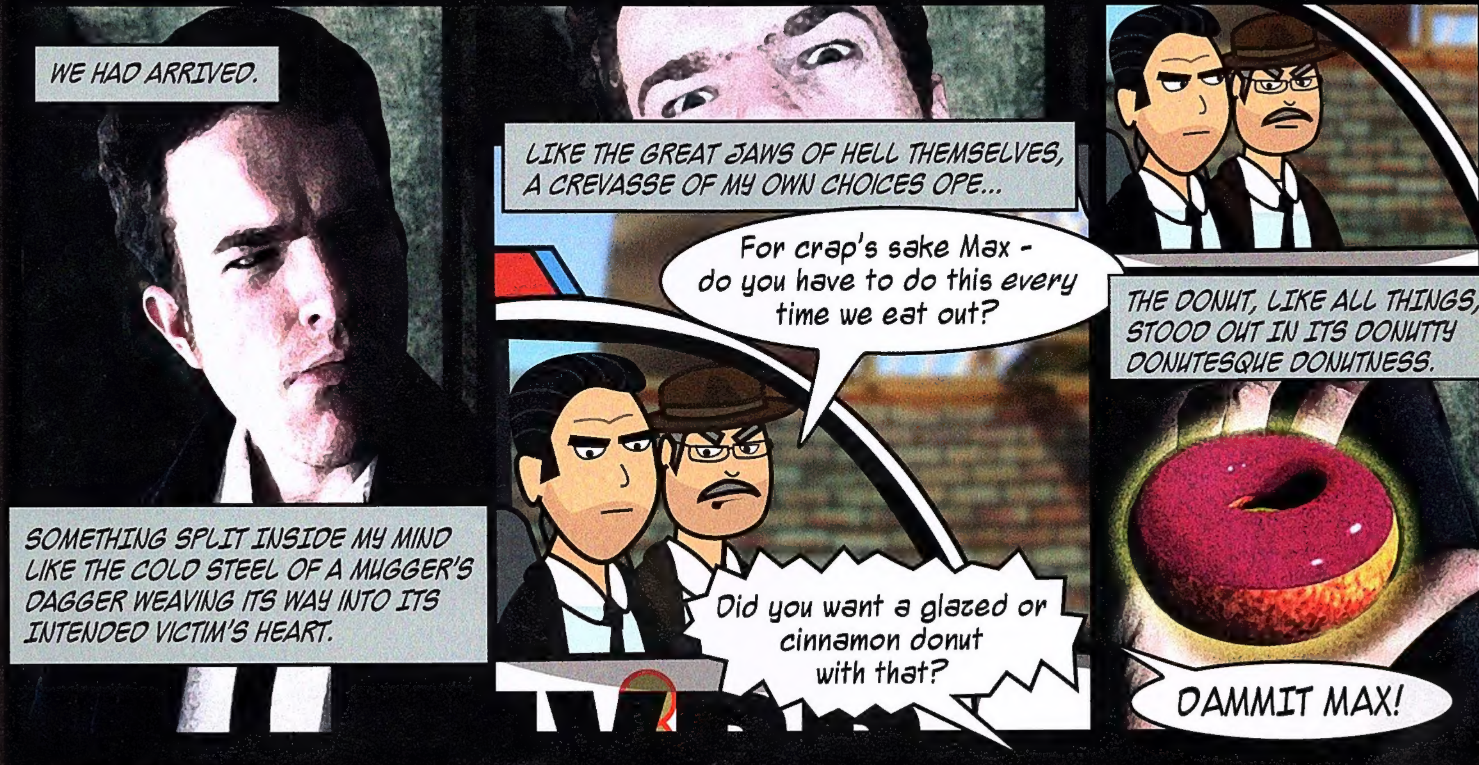
Throws were carefully thought out; they involved a smooth overarm action with the product being released at head height. The Theodolite was then used to measure the distance, as accuracy to the millimeter was needed – a normal tape measure was not sufficient.

As the test throws were being conducted we realized that the results would have to be corrected in order to achieve a standard measure of reliability. This stemmed from the fact that a half-kilo lump of copper can fly much further than a much lighter video card. Hence, all the items were tested against a reference weight.

The results tallied nicely with what we already knew. For example, think about ATX cases,. Everyone knows that shiny, brushed aluminium cases are definitely the most desirable. Thankfully, they also excel at FrisbeeMarkTM – they manage¬¬¬d a much longer distance than the everyday steel cases. Also, contrary to popular opinion, red cases do not fly faster than black ones. Unfortunately, cases with integrated cooling systems had barely any airtime, and may have done permanent damage to Chris' back.

It was the excellent replicability and experimental accuracy that got us excited about FrisbeeMarkTM, and we were on the way to the patent office when some unnamed party pooper pointed out that the products we tested were now totally destroyed. For now at least, this has meant an end to our experimentation. However, the team is already on the lookout for a very large padded cell to continue its work in. Any offers are more than welcome.

crashtest #9 - The Everyday Life of Max Payne


WE HAD ARRIVED.
SOMETHING SPLIT INSIDE MY MIND LIKE THE COLD STEEL OF A MUGGER'S DAGGER WEAVING ITS WAY INTO ITS INTENDED VICTIM'S HEART.
LIKE THE GREAT JAWS OF HELL THEMSELVES, A CREVASSE OF MY OWN CHOICES OPE...
For crap's sake Max - do you have to do this every time we eat out?
Did you want a glazed or cinnamon donut with that?
THE DONUT, LIKE ALL THINGS, STOOD OUT IN ITS DONUTTY DONUTESQUE DONUTNESS.
DAMMIT MAX!

Why so serious?

Ben Mansill reaches out like a Kubrick chimp, touching the Monolith of ancient times.

I bloody love First-Person Shooters. In equal measures, the sugar is being inside the latest shit computer tech can do, along with a feeding of fresh creative storytelling, art and game-world design. Even a bad FPS does this better than good games in other genres.

Occasionally I'll be so swept up by rare examples of awesome perfection that I'll plain forget to appreciate what goes into a game, just flowing with it as completely as a kid wrapped in a bedtime story. I love it when that happens.

Quake was the first full-wood and full-3D game that combined technical wonder with total suspension of reality immersion. But it didn't have a story. Didn't need one either; being a crazy weird scary place full of monsters you had to kill was well enough.

Through the mid to late nineties the FPS genre developed quicker than a hurricane off Florida (if it was one of those five-year long hurricanes). The focus (in my universe, at least) was just a mad hunger for more 3D worlds, anything at all please, set against the great fun 3dfx vs. ATI vs. Rendition vs. Video Logic vs. Nvidia vs. Matrox 3D battle. As it flowed on from Quake, there wasn't any realistic expectation of a proper story, and that was largely as a result of how iD was structured, and that we were all familiar with the staff and their jobs. We knew John was the coder, while John, Sandy and American were the level designers. John, Paul, George and Ringo. No Tolkien. Other development teams were mostly just bigger versions of the same baseline structure.

Monolith's games had story. By story, I mean a solid backbone holding together a really, really crazy world.

The ensuing and infuriatingly slow two to three year gestation period for proper 3D FPS was mildly disappointing, at least until Deus Ex and Unreal smashed in. Awesome that they were, it was cliché space marine city for Unreal, while Deus Ex magicked us away with an exquisitely meshed combo of pretty much every other game cliché, which also happen to make up 99 per cent of the market today.

Lucky, eh, that the apex peak of the Doom-clone era was raining seriously classic games throughout that period. A whole heap of them from Monolith, which went on to be the third player in the 3D engine wars, holding a solid third place after iDTech and Unreal.

Monolith's games had story. By story, I mean a solid backbone holding together a really, really crazy world. Monolith did world better than anyone, then, and into its glory era as it charged into true 3D with the Lithtech engines, seemingly without any of the delays to acclimatise to really hard programming that the other studios needed.

Monolith's best games were silly. Beautifully, happily silly, to everyone else's serious. Other games were awesome, but Monolith's were fun.

Blood sets you as a total psychopathic bastard taking pleasure from wasting anything that moves, except it was so over the top cliché ridiculous all you could do is laugh as you play. Shogo: Mobile Armour Division lets you mech-stomp around a city where most buildings are smaller than you are. No One Lives Forever; a game I really miss, is all lurid 1960's mod (the social sub culture, not the game 'mod'), you're a red hot secret agent babe and it's all just so incredibly cheesy. Think Austin Powers, the game, and you're there. Man, it was aweome… Its sequel was more of the same, and for a brief flash there it looked like N.O.L.F. was shaping up to be an ongoing series.

Monolith games had a distinct look and feel. Standout features include bright, bold and unusual colour palettes, sometimes awash, like in N.O.L.F or Blood, sometimes done with such artful subtlety that your eyes weep at the beauty. Tron 2.0 is one such.

Monolith always seemed to skirt around the edges of hitting bigtime success. Time Warner bought 'em in 2004, publishing the MMORPG The Matrix Online a year later. The Matrix. Online. Yeah, it sounded awesome back then too… even despite Dave Perry's lazy-arsed bullet to the head of the idea that: If Matrix game=must be good.

Monolith's history is a sea of fantastic games which never took hold or busted blocks like its formulaic competitors. Of the 27 games which Monolith either developed or published, only three ever spawned sequels. Blood, No One Lives Forever and its big fat hit; F.E.A.R.

F.E.A.R. is the cash cow Monolith always needed, pity it's largely, or entirely, devoid of the quirky charm that stamped earlier games. It may have supernatural stuff, but it's still spec-ops cliché-o-rama. That's not the Monolith I remember and love, despite that the F.E.A.R. games are well made and good fun.

So come on Monolith, we love you, but please be silly again, the world needs a little bit of that.

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